

## Tickling

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### Glossary

**Affect** Feeling or emotion.

**Duchenne smile** A smile, usually elicited during positive emotions, that includes upturned lips accompanied by a crinkling of the skin around the eyes.

**Fixed action pattern** A stereotyped sequence of behaviors that is triggered by a releasing stimulus.

**Gargalesis** Laughter-inducing tickle elicited by a somewhat strong pressure repeatedly applied to certain ticklish areas of the body. This form of tickle cannot be self-induced.

**Knismesis** Type of tickle that is elicited by a light movement across the skin and is not usually associated with laughter. The sensation can be readily produced in the self.

**Ontogeny** Development.

**Reflex** An unlearned, involuntary, automatic response.

Almost everyone has at some time been tickled by a friend or relative. Tickling is a favorite method used by parents to get their infants to laugh and young couples often include tickling in their courting behavior. Given its common occurrence, tickling might seem like a rather simple straightforward social behavior. However, a closer examination of the phenomenon of tickle reveals a number of peculiarities. The fact that a physical touch can produce smiling and laughter – responses that are normally elicited by psychological stimuli such as comedy – is odd, in and of itself. However, it becomes even more puzzling when one considers that despite outwards signs to the contrary, many people report that they do not enjoy being tickled. Another peculiarity is that one cannot make oneself laugh via self-tickling.

The mysterious nature of tickle has been pondered for over two millennia by some of the greatest minds in history including Aristotle and Plato, Galilei Galileo, Francis Bacon, and Charles Darwin. Despite the long history of interest, the empirical research on tickle is rather scant, but has been growing in the last decade or so. This article will discuss both the theories and empirical research that exists on tickling, particularly focusing on issues surrounding the smiling and laughter it induces.

### Two Forms of Tickle: Knismesis and Gargalesis

The English word 'tickle' seems to refer to at least two rather distinct, although perhaps not mutually exclusive, phenomena. One is the peculiar sensation, sometimes characterized as a moving itch, caused by a very light movement across the skin. This type of tickle can easily be elicited almost anywhere on the body by moving one's finger lightly across the skin. The annoying sensation can outlast the stimulation by many seconds, and creates an intense desire to rub or scratch the tickled surface (doing so seems to terminate the sensation). Of note, this form of tickle rarely makes people laugh. By contrast, the tickle that causes laughter usually requires a heavier pressure repeatedly applied to specific areas of the body such as the armpits or ribcage. The distinction between these two types of tickle was noted as far back as 1897 by the prominent late nineteenth century psychologist G. Stanley Hall in the *Dictionary of Psychological Medicine*. Hall and his colleague,

Arthur Allin, suggested that the light tickle be called 'knismesis' and the laughter-inducing heavier tickle, 'gargalesis.' The distinction between these two types of tickle, however, seems blurred when one considers the feet. Deep pressure to the foot produces a sensation of massage for most people, while a somewhat lighter touch often produces laughter.

Knismesis seems clearly different from the arguably more mysterious gargalesis. For one thing, as noted above, knismesis generally does not produce laughter, which in many ways is the most perplexing aspect of tickle. Second, people can readily elicit the sensation of knismesis in themselves, however, they cannot successfully produce gargalesis in themselves (i.e., tickling oneself does not elicit laughter).

Finally, it seems easy to imagine an evolutionary function for knismesis: the annoying sensation prompts one to scratch or rub the tickled spot, thereby removing insects or parasites that might be crawling on one's body.

### Tickling in Nonhumans

Knismesis, the response to very light touch, appears to be widespread across many mammals. The reactions of a dog scratching its side at a flea, or a cat flicking its ear at a mite are commonplace.

Gargalesis may not be as frequent in the natural world as knismesis, but work by primatologists suggests that chimpanzees and at least some other primates such as gorillas tickle each other in the course of rough-and-tumble play, producing what seems to be a nonhuman primate equivalent of laughter. A chimpanzee's laugh sounds different from a human's laugh – it is more of a breathy panting sound. This panting, accompanied by a relaxed open-mouth and quivering lower jaw, appears to be the phylogenetic precursor of human laughter. There is little doubt that tickling can induce such reactions in young apes.

Researchers working with rats have also noted that the rapid movement of human fingers on the back of the neck of juvenile rats causes the rats to emit high-frequency ultrasonic vocalizations. A number of researchers have referred to this as rat tickling, but it is unclear whether it bears any relationship to the tickle response of humans.

## Ontogeny of Tickle

Newborns do not laugh. In fact, babies do not begin showing laughter until around 4 months of age. Their laughter in response to being tickled is even a bit more delayed – usually emerging around 6 months. Various views have been offered on the connection between the development of humorous and ticklish laughter.

One hypothesis is that ticklish laughter is itself a conditioned response that emerges out of other humorous play. Perhaps children laugh when tickled because tickling has always taken place in playful situations in which laughter is already occurring. This repeated pairing could lead to Pavlovian conditioning whereby laughter then becomes associated with tickling movements, even when not paired with other humorous situations. Another possibility is that children laugh when tickled because of the laughter of the tickler which creates some contagious loop (e.g., a parent's laughter causes the child to laugh which increases the parent's laughter, and so on).

In the 1940s, Clarence Leuba from Antioch College came up with a clever way to test whether laughter in response to tickling would emerge even if tickling were never paired with other laughter-inducing play or with laughter from the tickler. His subjects were two of his own babies. From the beginning of each infant's birth, Leuba and his wife deliberately refrained from tickling their children during playful situations. All tickling took place by Leuba while he wore a mask that obscured any possible facial expressions to ensure that the infants would not associate tickling with smiles and laughter. Despite all this, Leuba found that ticklish laughter emerged in both infants around the age of 6 or 7 months. Although this study has limitations, it suggests that laughter from tickling does not emerge because of tickling being paired with other humorous or pleasant stimuli.

Others, such as Alan Fridlund from the University of California at Santa Barbara, have suggested the reverse causal sequence – perhaps humorous laughter emerges from ticklish laughter. Babies differ in the degree to which they respond to tickling. Parents of easily tickled babies are more reinforced for engaging in tickling (i.e., their infants' laughter is a positive experience) which probably leads them to do it more often. Such play then might be extended to include other forms of humorous physical interactions and eventually to mental stimuli, thereby leading offspring to laugh at humor as well. Such a view, however, has difficulty accounting for the fact that ticklish laughter appears to develop slightly later than laughter that emerges from first primitive forms of humor (e.g., playful menacing such as 'I'm going to get you').

## Positive Emotion and Tickle

The fact that smiling and laughter occur during tickling and during humor has led many writers to assume that the two reflect the same positive emotional state. One prominent champion of this view was the father of evolution, [Charles Darwin \(1872\)](#), who noted that "the imagination is sometimes said to be tickled by a ludicrous idea; and this so-called tickling of the mind is curiously analogous with that of the

body" (p. 199). Darwin pointed out several similarities between tickle and humor. First, he claimed that in order for either to elicit laughter, one must be in a pleasant hedonic state. He wrote "in this case, [humor] and in that of laughter from being tickled, the mind must be in a pleasurable condition; a young child, if tickled by a strange man, would scream in fear" (p. 199). Second, he noted similarities in the elicitors of each state, "The touch must be light' in tickle and 'an idea or event must not be of grave import' in humor. Finally, he pointed out that an element of surprise is required to elicit laughter to jokes or to humor. In essence, tickle was simply a physical joke. Many contemporary writers on this topic echo the view that ticklish laughter and smiling are signals of a positive affective state.

My colleague, Nicholas Christenfeld, and I examined the relationship between tickle-induced laughter and humor-induced laughter in the laboratory. Previous research had found a warm-up effect for humorous laughter: jokes that occur later in a series are funnier than those that occur earlier (presumably this is why 'warm-up' comedians give performances on stage before the top comedian does his or her routine). We reasoned that if ticklish laughter and humorous laughter reflect the same psychological state, there ought to be a 'warm-up' effect that transfers from tickling to humor and from humor to tickling. To examine this, subjects watched a videotape composed of the highlights of several comedy routines. They reported finding the comedy humorous and readily laughed and smiled while watching it. The connection between this type of laughter and that of tickling was tested by having a researcher tickle subjects either immediately before watching the comedy tape or immediately after watching the tape. Subjects laughed, smiled, and wiggled when tickled, but they did so to the same extent regardless of whether they had first been 'warmed up' with the comedy tape. Likewise, having just been tickled did not make people laugh more while watching the funny film. The lack of a warm-up effect between humor and tickle lends some support to the hypothesis that tickling-induced laughter is not simply a form of humorous laughter.

Another recent experiment also suggests that the tickle-induced smiling need not reflect positive affect. The proposition that the tickle response is due to humor has been based largely on the assumption that the smiling that is elicited during tickling is indeed the same as that which occurs during amusement. The facial expression that occurs during positive emotion usually includes two muscle movements: the upturned lips or smile (produced by contraction of the zygomatic major), and a crinkling of the eyes (produced by contraction of the orbicularis oculi). This type of smile has been named the 'Duchenne' smile, after a French physician from the 1800s who studied facial expressions and noted the importance of the eyes in conveying positive affect.

To determine whether tickling produces similar facial displays as humor, Nancy Alvarado and I conducted a detailed microanalysis of the facial displays of subjects while they were being tickled. Although Duchenne smiles were sometimes elicited during tickling, the smiling was different from that of humorous smiling in several ways. Some people showed Duchenne smiles while being tickled even though they did not report feeling pleasant emotion (i.e., happy or amused). In fact, for some of these participants, Duchenne smiling was

associated with finding the tickle sensation unpleasant. Moreover, people who said that they generally enjoyed being tickled did not display more Duchenne smiles than people who generally did not like being tickled. The dissociation between smiling and self-reported positive affect during tickle provides some support for the hypothesis that Duchenne smiles during tickling can occur even when people are not feeling positive emotion.

Thus, several findings suggest that ticklish smiling need have no closer an association to merriment and mirth than crying when cutting onions has to sorrow and sadness. However, such a conclusion does not imply that positive emotions never occur during tickling, just that positive affect is not required.

### Sociality of Tickling

A great number of writers across the ages have argued that the interpersonal context, including beliefs about who is doing the tickling and why, plays an indispensable role in whether or not tickling will induce laughter. For example, it is often assumed that the tickling must be done in a playful way with benign intent by someone that is not only known but also liked. Such ideas clearly have intuitive appeal, particularly since they would appear to provide a possible account for one of the greatest mysteries of tickling – why can't one elicit ticklish laughter in oneself? The answer, according to an interpersonal account, is that tickle-induced laughter, at the very minimum, requires the belief that another person is doing the tickling.

So how might one test this idea? One possibility would be to build a fully automatic tickle machine and see if it could make people laugh. At first blush, this might seem to be the perfect way to test whether tickle-induced laughter requires an interpersonal context. After all, if such a machine made people laugh, it would suggest that ticklish laughter does not require another person. However, if people did not laugh in response to the machine, one could never be certain whether the lack of laughter was due to their knowledge that it was a machine or the failure of the device to accurately mimic movements of a human hand.

To get around this problem, my colleagues and I created a 'mock' tickle machine in the laboratory using a robotic-looking plastic hand, a vacuum cleaner hose, and a nebulizer (a device used for asthma) to provide sound effects. Then, in an experiment, subjects were blindfolded and told that they would be tickled twice, once by the machine and once by the experimenter. In reality, the machine was not actually capable of movement. Instead, all the tickling was done by a research assistant, who was hidden under a cloth-draped table near the subject. The assistant was careful to perform the tickling the same way throughout the experiment, thereby allowing assessment of whether the belief that the tickling is being performed by another person is essential to elicit laughter. To decrease the interpersonal context even more, for half of the subjects, the experimenter left the room during the machine-tickle phase.

It turns out that subjects readily smiled, laughed, and wiggled when tickled by what they believed to be a fully automated mechanical device, and did so to the same extent as

when they thought they were being tickled by a person. Furthermore, these reactions were not diminished even when the subjects believed that the experimenter had left the room and that they were entirely alone with the machine. Self-reports of tickle intensity were also the same regardless of who was supposedly doing the tickling. These findings provide rather compelling evidence against the popular notion that ticklish laughter requires the belief that another person is performing the tickling. (Careful probing at the end of the experiment confirmed that subjects truly believed that the machine had tickled them.)

### Automatic Response

As described above, the handful of empirical studies on ticklish laughter suggest that it is not a response driven by positive affect nor does it require an interpersonal context. So what does underlie gargalesis?

The data that exist seem most amenable to the view that gargalesis is a relatively automatic, low-level physiological response. This general view is consistent with the writing of G. Stanley Hall and Francis Bacon and has been advocated by several researchers in more recent times. Findings to date have not revealed exactly what mechanism controls the response but likely candidates are that it is a type of complex reflex or fixed action pattern. In literature on human behavior, the term, fixed action pattern, is sometimes replaced with terms such as species-characteristic or species-typical stereotyped motor pattern requiring a particular releasing stimulus. The boundaries between reflexes and other species-typical behavioral dispositions remain controversial. Reflexes are distinguished from fixed action patterns based on their graded character: the more intense the stimulation the more intense the response. It currently is not known whether ticklish laughter shows an all-or-none character like a fixed action pattern or a graded response to the magnitude of stimulation as with the typical reflex.

If gargalesis is some type of complex reflex or species-typical stereotyped behavior, then why can we not elicit it in ourselves? After all, we can tap our own knees and produce the knee-jerk reflex. There are, however, other reflexes that one cannot elicit in oneself – startle being a prime example. Startle and tickle appear to share some features. Both appear to require some element of unpredictability or surprise – one can no more tickle oneself than startle oneself (at least, not without the use of some external device such as a gun). The two states also produce facial expressions that resemble the types of expressions elicited during emotion, but are arguably not emotional states in and of themselves. The proposition that tickle is a reflex, or other kind of innate stereotyped motor pattern, does not imply that the tickle response is unmodifiable or unaffected by mood or other psychological states. For example, the startle reflex can be potentiated by negative emotion while the opposite effect is produced by positive emotional states and even by a faint warning signal. Despite the name, 'fixed action patterns' also permit substantial variability in behavior.

There is also another explanation consistent with gargalesis being a low-level physiological process and with one not being able to produce it in oneself. Lawrence Weiskrantz and his

colleagues, in a paper that appeared in *Nature* in the 1970s, suggested that the neurological processes observed in vision might provide an answer. When the eyes dart from one focal point to another, the world does not appear to jump because the brain takes into account that it has issued a command (efferent signal) to move the eyes. Weiskrantz and colleagues reasoned that similarly when the brain issues the command to self-tickle, it sends a message to cancel the sensation of ticklishness. Thus, what is sometimes termed exafference (stimulation uncorrelated with a motor command) may be required to elicit the tickle response.

### The Unpleasant Side

Socrates proposed that although tickling could induce pleasure, to a greater degree it elicited pain. Bacon suggested that “tickling is ever painful, and not well endured” (p. 161). There also have been stories across the ages of people being tortured to death using nothing but unrelenting tickle. Whether victims can actually die from tickle alone is not known. However, there is little doubt that prolonged tickling can be highly disagreeable.

Research with college students suggests that even short bouts of tickling can be unpleasant for some people. Detailed coding of the facial displays during tickle, suggest that several movements are similar to those that occur during pain, including wrinkling the nose, raising the upper lip, and grimacing. Furthermore, such facial displays can occur while people are simultaneously smiling.

It is often assumed that tickling is a more pleasant sensation for children than for adults. However, there are several reasons to question this. For one, childhood is often when the displeasure of ‘tickle torture’ is discovered. Generations of children have found that holding one another down and engaging in relentless tickling is an effective way to torment a sibling or playmate. While children sometimes seek out tickling, it may be incorrect to assume this means that the sensation itself is pleasurable. Children also take part in games in which parents play at startling or menacing them. Presumably, such behaviors do not indicate that children enjoy startle or fear. A combination of thrill-seeking and pleasure in tactile contact might lead children to seek out what is still an intrinsically aversive sensation.

### Physiology

The neural mechanisms that are responsible for the tickle sensation are not well mapped out, but touch and pain fibers are two possible candidates. Work on the receptors involved in tickle focuses almost exclusively on knismesis, usually elicited by brushing a piece of cotton wool on the skin of an animal or person. Yngve Zotterman, a pioneer in cutaneous sensation research, used this method on cats while recording action potentials of nerve fibers, and concluded that light tickle depends, at least partially, on pain fibers. Responsiveness to tickle elicited by cotton is also reduced in patients who have had tracts of pain fibers in their spinal cords severed as a treatment for intractable pain. However, gargalesis may rely

on different pathways given that tickle-induced laughter is retained in at least some patients who have lost pain sensation due to similar spinal-cord surgery.

Knismesis seems to also depend on touch fibers: when limb circulation is arrested, sensitivity to touch and tickle is eliminated before pain sensitivity. However, the density of touch receptors is not likely to explain the susceptibility of different body parts to tickle, because the areas most responsive to tickle do not show any obvious advantage in touch sensitivity or in tasks requiring people to tell whether they are being touched on one or two nearby points. For example, the palm is more sensitive to touch than the sole of the foot, but the latter is more ticklish.

Other research has attempted to explore differences in brain activity using the technique of functional magnetic resonance imaging (fMRI) during self-generated and externally generated tickle. Such work has exclusively looked at knismesis which, since it can be produced readily in oneself, is unlikely to inform us much about why we cannot produce ticklish laughter in ourselves. Given the requirement to remain still during fMRI scanning, it is doubtful whether such measures will be a good tool for studying gargalesis as laughter disrupts the imaging.

### Functional Theories

Several theories of why humans may have evolved a tickle response have been offered, although providing evidence for such functional explanations remains a challenge.

One hypothesis is that tickle evolved to promote protection of areas that would be most vulnerable during arm-to-arm combat. The idea is that ticklishness in such areas motivates one to protect these areas and thereby confers an adaptive advantage (i.e., increased ones ability to survive and reproduce). This provides a possible explanation for the pulling away and fending off movements frequently encountered during tickling. However, it does not account for why the hands and fingers, which are quite vulnerable in hand-to-hand combat are not very ticklish, nor why people laugh and smile during tickling.

Another functional account, alluded to earlier, focuses on the smiling and laughter during tickling. Humans find such expressions rewarding which may facilitate bonding between parents and infants. This view, however, does not explain the defensive and withdrawal movements that occur during tickling nor why the sensation of tickle is considered unpleasant by many.

A third possibility draws on different aspects of these views: the disconnection between the inward unpleasant sensation and the outward pleasant expression may be what is adaptive. Tickle may elicit smiling to encourage others to perform the tickling and may elicit discomfort in the one being tickled in order to motivate the developing primate to avoid the tickling. This would promote rough and tumble play that may help the development and acquisition of combat or other skills that have survival benefits. Unfortunately, testing such hypotheses regarding ultimate mechanisms is notoriously difficult. Furthermore, it is always possible that tickle is not an adaptation per se but rather a by-product of a mechanism designed for some other function.

## Final Remarks

Despite 2000 years of speculation on tickle, the paucity of actual research makes it difficult to draw unequivocal conclusions about this enigmatic aspect of human behavior. However, what does seem to be emerging from research is a recognition that tickle is not merely a special case of amusement or joy. Depending on the social setting (e.g., the relationship with the tickler, the tickled person's mood) tickling may be capable of eliciting a variety of reactions, some enjoyable and some unpleasant. But, it is doubtful that the smiling observed in tickling is dependent on the positive or interpersonal aspects of the situation.

The data to date suggest that tickle is most likely a low-level automatic physiological response such as a complex reflex, fixed action pattern, or other species-typical stereotyped motor pattern. It is also possible that tickle may turn out to exemplify some class of phenomena not yet mapped out.

*See also:* [Facial Expression of Emotion](#); [Pain](#); [The Sense of Touch](#); [Touch](#).

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