

## Language



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### What Is Communication?

Communication is the process through which one individual transmits information to another. This process involves some form of behavior, such as the production of a signal that is generated by one individual that acts as a sender and is transmitted to another individual that acts as a receiver. When a receiver is present to perceive the sender's signal and process the associated information, communication is said to have occurred. Others have clarified this distinction as, "Communication does not begin when someone makes a sign, but when someone interprets another's behavior as a sign" (Knight et al. 2000). In many forms of communication, the sender can then transmit another signal in response, and thus both individuals take on both roles in the course of communicating. The information from a sender can be transmitted in many different ways. For example, the information can be as simple as one organism being seen by another and thus revealing its location. That same information can also be conveyed through other modalities, such as listening to the

sounds that a distant organism produces and determining its location in that way. These are very simple examples of information being transmitted, but exchanged information can also be much more complex, as is the case of the detailed information contained in a recipe for chocolate cake or the nuanced information conveyed in a friend's warm smile and cheerful tone of voice.

One of the most familiar forms of communication that humans use is language. Language is an especially efficient means of communicating complicated ideas quickly and effectively, and it is a powerful tool to help people describe their ideas, express their emotions, and understand the thoughts and feelings of others. Language involves the use of sounds or written symbols, and these constitute a lexicon through which a sender imparts information to a receiver. This is often done by taking turns, such as alternation of speaking during a conversation or an exchange of texts or emails, and individuals who are fluent in a given language use those sounds and symbols equally well as either sender or receiver. The ability to use those relatively few sounds and symbols in specific arrangements to convey an amazing diversity of complex ideas is thought to be a defining characteristic of human cognition (Prather et al. 2017). In the following sections, we will discuss spoken and written language as a means of communication, the influence that language has had in humans' emergence as the dominant species on our planet, the cells and circuits through which the nervous system enables

communication through language, and the ways in which those insights relate to our understanding of how humans communicate in ways other than spoken or written language.

## What Is a Language?

Despite being such a prominent feature of our everyday experience, language can be challenging to define. Some researchers have defined it as “a system of arbitrary vocal symbols by means of which a social group cooperates” (reviewed in Cyelan 2017). This definition captures language as an entity that is communicated through speech, but it leaves unaddressed the ways that we communicate using written language, as in the case of this text, or manual gestures, as in the case of signed languages. Others have described language as the ability to communicate, as both sender and receiver, using a specific and shared set of symbols such as sounds or written letters (reviewed in Cyelan 2017). This much broader definition is consistent with what many people mean when they use the term language, but it also leaves open questions about how different a set of symbols must be in order to identify them as different from those of another language. For example, even among people who are fluent in the same language, no two people speak in exactly the same way. These individual idiosyncrasies do not impede the process of communication, so those two people would be described as each speaking the same language. If we look beyond individual speakers, we can sometimes encounter much greater differences in pronunciation or terminology, and these are often distributed across different geographical regions. These localized differences are called dialects of the language, as their differences are clearly detectable, but they do not hinder an individual’s performance as either sender or receiver, and therefore they do not impede the process of communication. These examples highlight that there can be variation in how the symbols that comprise a language are produced by different individuals. There is no single definition of how much variation is required to establish a boundary between different

languages, but it is clear that successful communication is the primary requirement in considering whether symbols constitute different languages. In that light, a useful functional definition of language is a set of symbols through which senders and receivers can exchange information, express ideas and emotions, and influence the thoughts and activities of others who share the same set of symbols.

In communication through the use of language, information can be transmitted through vocal gestures, as occurs in spoken conversations, or through written symbols or other forms of manual gestures, as occurs when we write or type letters such as those you are reading now. These types of complex vocal and manual gestures are inherent to how we communicate using language, but complex behaviors alone are not sufficient to say that language is being used. For example, many animals use vocalization as an important form of communication, such as the roar of a lion or the songs and calls of a bird. Those vocalizations are key elements of how those species communicate, but they are typically used to communicate relatively simple information such as territoriality or aggressive intent (Catchpole and Slater 2008). In other species such as chimpanzees, individuals modify their use of vocalizations in different social contexts such as different calls in association with food sources of different sizes (reviewed in Cheney and Seyfarth 2018), but even those vocalizations are lacking a key feature that defines communication through use of human language. That feature is the rules-based organization of symbols into combinations through which complex information can be transmitted. These have been referred to as the “design features of language” and more recently as the “faculty of language,” and they include things like the ability to structure words in such a way that they refer to abstract ideas or objects that are not physically present, or they clarify that the sender is describing the past or the future, or they provide the sender with the ability to use language to talk about language just as we are doing here (Hauser et al. 2002; Pinker and Jackendoff 2005; Waciewicz and Zywiecynski 2015). Through the symbols and organizational rules of language

such as recursion, fluent speakers can assemble a finite set of symbols into different combinations to reliably communicate an infinite set of facts, thoughts, and emotions. Thus, a central aspect of the beauty and importance of language lives in the ability to create the infinite from the finite. By applying the rules of linguistic structure, future plans can be made, and the consequences of possible actions can be considered. Objects can be referenced and described even if they are unfamiliar because they existed far away or long ago or even if they may have never existed at all.

No set of behaviors with as much complexity and communicative power as human language has ever been described in other species. Some aspects of those communicative advantages are present in the behaviors of other species, such as a bird's identity being detectable from the traits of the songs that it sings or a bird's ability to produce strings of sounds with patterning that has led some to speculate that it constitutes a form of syntax (Catchpole and Slater 2008; Gentner et al. 2006). However, none of those vocalizations appears to have anything approximating the descriptive and referential power of the sounds that we use in language, and no set of animal behaviors incorporates all of the traits that define human language. Interestingly, bees appear to be able to use their complex "waggle dance" behaviors to communicate about the location and quality of food sources (Price and Gruter 2015). This has led to speculation about the intellectual capacity of bees and whether their movements related to food may meet some of the criteria to call those behaviors a rudimentary form of language. Although elaborate and useful to communicate specific information, those behaviors appear to be restricted such that they are used only to refer to food sources and relevant navigational information to find those sources. In contrast, humans are unrestricted in what we can describe using language. In some cases, training or other forms of relevant experience may be necessary to communicate about abstract ideas or new discoveries, but that can be readily achieved by fluent speakers, and the ability to learn and achieve such expansion highlights the power of language as a tool to link current status to almost unlimited future possibilities.

A key feature of communication through language is that both the sender and the receiver must use the same set of symbols. This highlights the role that learning plays in acquiring those symbols and developing fluency in a language. As detailed in a later section, the ability to communicate using language is an imitative form of learning. Factual content appears to be learned intentionally, such as the fact that a canine pet is called a "dog" in English, but the fact that we learn language at all appears to emerge from a natural predisposition to interpret the noises made by others as meaningful signals (Pinker and Jackendoff 2005). Language is typically acquired during very early life, with nascent speakers learning the sounds that comprise their native tongue by listening to the sounds produced by others around them (reviewed in Prather et al. 2017). Humans are extraordinarily skilled in our ability to hear the detailed features of sounds used in language, as evident in the features of different regional accents often shared by children and the parents from whom those children learned their language. This link between sounds that are heard and sounds that are produced relies heavily on the sense of hearing, with a healthy sense of hearing being essential for young speakers to learn those sounds and refine their imitation of those model behaviors (reviewed in Prather et al. 2017). This is most clearly evident in people who are deaf or experience other forms of hearing impairment. People who are deaf from birth have great difficulty acquiring and refining the sounds used in spoken language. Even among people who achieve complete fluency prior to any hearing impairment, their clarity of spoken language is typically reduced if their hearing impairment is severe or prolonged. Other animals such as parrots and songbirds are also very skilled at imitating the sounds they hear produced by others, and these species are even capable of expressing regionally distinct features that are sometimes described as dialects. Yet despite the complexity of their songs and their skill in imitative learning, there is no evidence that birds are capable of using their vocalizations to refer to a range of different ideas or otherwise communicate with the complexity and productivity of human language. Together,

these examples from the animal kingdom serve to highlight the extraordinary utility of human language. In fact, the ability to communicate so broadly and so effectively through language appears to be uniquely human.

## Written Language and Its Role in Human History

Writing enables thoughts and emotions that are expressed in language to persist through time, and it enables the accumulation of information far beyond the knowledge of any single individual. Through translating thoughts into a system of symbols, thoughts can last far longer than a single utterance or even a single lifetime. Those symbols can represent entire words, as in the characters used in Chinese, Japanese, Korean, and Vietnamese writing, or they can represent consonant and vowel sounds arranged in a specific sequence, as in the letters of the English language that are used here. This latter form of written representation constitutes an alphabet, and the individual letters represent the basic sounds of language (Bright and Daniels 1996). The first use of an alphabet to represent linguistic sounds is thought to have occurred among the Phoenicians, and those written symbols were used as a tool for communication in trade throughout the Mediterranean area (Bright and Daniels 1996). That system is thought to have influenced the development of the Greek alphabet, as the Greeks adapted the Phoenician writing system to represent the sounds they used in their own language (Bright and Daniels 1996). The Greeks built on the Phoenician writing system to create a system with individual symbols that represented both consonants and vowels and that could be arranged in a linear sequence to communicate information. For this reason, some people consider the Greek writing system to be the first true alphabet (Bright and Daniels 1996). Others further adapted the Greek system for their own needs, such as the Latin script that was an ancestor of the 26 letters that compose the English alphabet (Bright and Daniels 1996).

Alphabets were transformative because they enabled people to archive their thoughts. Prior to

that, the ideas and traditions that compose a people's culture were passed from one generation to the next orally. Writing enabled those stories to be collected and placed into reservoirs that could be preserved and consulted anew by members of subsequent generations. These reservoirs, which we call "books" in English, were originally made from thin bits of material taken from the bark of trees. The Latin word for that material (*librum*) gave rise to the terms *liber* to refer to what we would call a book and *librarium* to refer to a place where books were collected and stored. In its earliest days, creating books was a very laborious task, with scripts written by hand onto sheets of fragile material that were very challenging to store and preserve. It could take a very long time to create even a single book, and it was even more challenging to create multiple copies. Thus, books were a means of archiving information if they were stored very carefully and protected from catastrophic events such as the fire that engulfed the Library at Alexandria in 48 BCE, but books were still not practical as a means of disseminating that archived information.

A key advance in our collective ability to archive and share information broadly came in the year 1493 when German inventor Johannes Gutenberg invented the printing press. Modeled on the wine and olive presses of that time, Gutenberg's means of pressing paper onto movable type could produce finished sheets much more quickly than the speed at which texts could be copied by hand. This was vastly more efficient, and it enabled more rapid production of texts that could be shared among many readers. Advances in the ability to communicate have continued to emerge, and they now enable nearly instantaneous communication through electronic tools such as phones, texts, and emails. These advances have increased the speed and breadth of dissemination, but in their essence they all rely on language as the means through which communication is possible.

Language has given humans an amazing ability to describe and disseminate our ideas. With the assemblage of those ideas into culture and technological advances, language has been a key feature in driving our collective history. Through spoken and written language, humans have

communicated across space and time. That accumulated knowledge allows us to benefit from intellectual masterpieces produced by earlier thinkers, such as Plato's *Republic* and Newton's *Philosophiae Naturalis Principia Mathematica*. It allows us to revel in gripping stories, such as the *Epic of Gilgamesh* and the works of Shakespeare. It allows us to learn from the insights of others, such as Aesop's *Fables* and China's *Shangshu*. It allows us to share sacred texts, such as the *Torah* and the *Koran*, and it has allowed us to learn from historical documents, such as the *Sumerian Code* and the *Magna Carta*, as we continue to refine the policies that shape our governments and social structure. Through these examples and countless others in our collective history, communication through language has shaped our conceptualization of technological and cultural wonders and our advancement as a species.

## Acquisition of Spoken Language

Ideas can be communicated and archived through written communication, but they can be brought alive through forms of behavioral emphasis such as changes in vocal pitch and emphasis that are expressed through intonation. Many concepts can be equally well conveyed through written or spoken language, but in some cases additional aspects of meaning can be communicated in speech that are difficult or impossible to express in written language. Just as punctuation plays a key role in written communication, intonation can play a key role in illustrating a person's meaning in speech, such as the rising intonation that occurs during the final words of a person asking a question in English. These prosodic elements can also clarify a person's complete meaning in words that might otherwise be easily misunderstood, such as occurs in emphasis, contrast, irony, or sarcasm (Purves et al. 2001).

The properties of speech can be described using parameters such as rhythm, articulation, and voice. Rhythm refers to the temporal organization and the sense of movement in speech, evident in the timing and stressed nature of some syllables, as well as the number of syllables in

each word (Gleason and Ratner 2016). For example, in the English language, unstressed syllables are spoken more quickly than stressed syllables, acting as an indicator of the focus of a message. Also inherent to rhythm are brief epochs of silence, with very short pauses used to separate words, slightly longer pauses used to separate phrases much as commas do in text, and longer pauses used to provide emphasis or to illustrate breaks between complete thoughts, acting in the same way that periods or paragraphs break written language into meaningful chunks. Articulation refers to the precise movements of the structures involved in actually producing the sounds used in speech, such as the lips and tongue (Gleason and Ratner 2016). Strictly speaking, these are elements of vocal production and therefore speech rather than aspects of the conceptualization that characterizes language. However, articulation is an integral part of producing spoken language, and disorders of that ability can complicate a person's ability to communicate. Voice (sometimes called "vocalization") refers to how we use our vocal folds and breath to create the sounds used in speech (Gleason and Ratner 2016). Voice is also used in ways other than speech. For example, voice serves as an auditory identifier such that we can recognize different individuals by hearing their voice even if other identifiers such as their face are not visible. Voice can also indicate emotional state, and these features can be detected even by newborn babies (Missana et al. 2017). Together, these features of vocal production and behavioral emphasis give rise to the rich and complex signal that is spoken language.

Spoken and written languages share the feature that symbols are used to represent specific thoughts. For example, either reading the word "dog" or hearing it spoken by your friend could equally well produce a mental image of a cute furry pet. As we noted earlier, information is communicated in written languages through symbols such as characters or letters. Those symbols can be combined to represent thoughts, and those thoughts can be communicated in their full rich entirety. In spoken language, the relevant building block of meaning is called a phoneme. Phonemes are perceptually distinct units of sounds that

distinguish one word from another (Gleason and Ratner 2016). As you listen carefully to spoken words, phonemes are the smallest unit of each word that provides specific meaning. For example, “cat” and “bat” are very similar in the middle and final portion of those words, but they are very different in their first sounds. The difference between those sounds is typically very easy for listeners to distinguish, and that facilitates a listener’s easy identification of those words and rapid realization of their meaning. Phonemes are produced with specific temporal patterns that allow the speaker to be understood by the listener. These rules that govern the structure of sentences in a language are collectively called syntax (Gleason and Ratner 2016). When a speaker fails to adhere to the syntax of a language, the listener may misinterpret or be unable to interpret the message being conveyed. When the many traits of a language such as rhythm, voice, and syntax, come together to enable rapid and efficient communication, a person has achieved fluency in that language (Gleason and Ratner 2016).

Fluency in a language is a learned behavior that we acquire by imitating other speakers of that language. Typically, language develops at a very young age, beginning at around 6–9 months of age (Gleason and Ratner 2016). Those first steps toward linguistic ability are often characterized by vocalizations that are difficult to recognize and consist of a series of sounds that is devoid of linguistic meaning. That stage of development is called babbling, and it is thought to be associated with young speakers developing their vocal control, preparing them to be able to repeat common words they hear and recognize the associations with those words (Gleason and Ratner 2016). This process of gradually learning to produce the phonemes that define meaning in spoken language and to bind informational content to specific sounds is the beginning of vocabulary and semantics (Gleason and Ratner 2016). As the young speaker continues to develop, they typically make grammatical or other errors of syntax, and these are usually corrected through experience or instruction from others. When these vocal, semantic, and syntactical features of spoken language improve in concert, the young

speaker is on their way to fluency of spoken language. That skill in spoken language then becomes the basis for subsequent acquisition of written language. Fluency emerges as the young person becomes progressively more skilled at communicating in both realms.

When the process of language development is successful, the individual acquires fluency as both sender and receiver, and communication can occur easily and reliably. However, difficulties in communication can emerge if either sender or receiver experiences challenges such as difficulty perceiving sounds, trouble producing sounds, difficulty with rhythm and continuity such as stuttering, challenges with voice control such as dysphonia, or other challenges that impair production or comprehension. These difficulties can cause communication to be slowed or complicated or to fail completely. Creating solutions to those challenges through the development of mechanistically targeted therapies will require an understanding of the neural mechanisms that are affected in each type of disorder. That desire to improve the lives of the many people impacted by those conditions has been the driving force behind over a century of research into how we learn, perceive, and perform the sounds we use in spoken language.

## Language and the Brain

The link between language and specific areas of the brain first emerged through studies that investigated speech deficits and corresponding injuries to specific regions of the brain. In 1840, a French patient named Louis Victor Leborgne was admitted to a Paris hospital with symptoms that included being able to utter only one syllable (Domanski 2013). That syllable was “tan,” and even though Mr. Leborgne could inflect his voice and he often accompanied that syllable with various expressive gestures, he could not speak any additional content. Whatever had happened to induce this state had left him with an impaired ability to communicate that was far from the fluency that he had previously enjoyed. Dr. Pierre Paul Broca had an opportunity to treat



Mr. Leborgne. Dr. Broca specialized in the study of language, and he found it very curious that a patient could suffer such a loss in one realm but be apparently unaffected in other faculties. Dr. Broca carefully documented this loss of the ability to speak in Mr. Leborgne and other patients, and in papers published in the 1860s he described a condition that we now call expressive aphasia or Broca's aphasia. When Mr. Leborgne died, it was discovered that he had a large lesion in a specific area of his brain. That area, the posterior inferior frontal gyrus in the left hemisphere of the brain (specifically the pars opercularis and pars triangularis, also described as Brodmann's areas 44 and 45), is now commonly referred to as Broca's area (Dronkers et al. 2007). This link between the sudden emergence of nonfluent speech and a corresponding brain injury was the first hint that a specific brain site could play such an important role in language.

In the years following Broca's discoveries, others also became interested in the possibility that injuries in other sites could also be related to the emergence of other types of language difficulties. In 1874, Dr. Carl Wernicke described another type of aphasia in which patients had fluent speech in which they could produce many different words, but those words were disordered to such a degree that it was difficult or impossible to understand the patient's meaning (Purves et al. 2001). His patients also commonly had difficulty understanding speech, and this was evident as impairment of their ability to follow directions or to repeat a sentence that they had just heard. This form of impairment is now called receptive aphasia or Wernicke's aphasia. After the patients expressing receptive aphasia died, it was discovered that their linguistic deficits were also associated with injury to a specific brain site, but in these cases the injuries were at a different site than reported for Broca's patients. These patients with receptive aphasia had damage in a region near the interface of the temporal and parietal lobes in the left hemisphere of the brain, in a region including the posterior portion of the superior temporal gyrus and other sites that are collectively called Wernicke's area (Mesulam et al. 2015). This led Wernicke and others to propose that specific

regions of the brain may be specialized to shape different aspects of behavior and that the full range of behaviors emerged through the interaction of those and other sites. Additional studies have also found other areas of the brain that are closely associated with other aspects of behavior, such as other areas near the classically defined Wernicke's area that also influence speech comprehension, and visual regions that contribute to how we recognize faces (Binder 2017; Cohen et al. 2019), but these early studies by Wernicke and Broca provided the first insights into the neural sites and pathways that play key roles in language (Hagoort 2019; Scott 2019; Tremblay and Dick 2016).

The fact that Broca's and Wernicke's areas both resided in the left hemisphere of the brain suggested that linguistic function could be lateralized such that it resides primarily or exclusively in the left hemisphere. Subsequent studies confirmed that there can be differences between functions associated with corresponding areas of the left versus the right hemisphere, but they have also revealed that language is affected to at least some degree by both hemispheres (reviewed in Taylor and Regard 2003). This is called hemispheric dominance, and in most people the left hemisphere is dominant for language (reviewed in Prather et al. 2017). The left hemisphere appears to play the dominant role in articulatory ability, such as being able to form meaningful sequences to respond to questions, but areas of the right hemisphere corresponding to Broca's and Wernicke's areas in the left hemisphere also contribute to subtle features of understanding that accompany linguistic ability. For example, patients with injury to those regions of the right hemisphere can lose the prosodic elements of language, such as intonation, stress on certain syllables, and the rhythm of speech production. Patients with injury to the right hemisphere can also have difficulty with word-association tasks, suggesting that the right hemisphere may help us to bind meaning to specific words, even if it is not directly driving articulation of those words. These patients can also have difficulty categorizing things or understanding metaphors, drawing inferences, or grasping the non-literal meaning of

idioms used in speech (e.g., “it’s raining cats and dogs,” Taylor and Regard 2003). Thus, the left hemisphere plays a dominant role in the production and comprehension of language in most people, but both hemispheres contribute to the full richness of communication.

The quest to continue expanding our understanding of the neural basis of language drives much current research. Central to that effort are studies of learning, as learning to imitate the sounds we hear perform by others is a central component in our acquisition of language. In its essence, that learning process consists of auditory perception instructing motor performance. When that process proceeds to accurate completion, imitation emerges. That is especially evident in the regional accents that humans express, such as the gentle lilt of accents from certain regions of the American South. If parents and others in the region speak with such an accent and their children model their vocal development on the sounds that they hear throughout development, then the children are very likely to imitate with sufficient precision that they also speak with that accent. Accents and other examples make it clear that the human brain is capable of very precise imitation in the acquisition and performance of language, but it remains unknown how the brain enables perception to inform motor performance.

Specialized brain regions in other species offer us a chance to gain high-resolution insight into mechanisms of imitative vocal learning. For example, songbirds acquire their songs by imitating the sounds they hear performed around them during their juvenile development (reviewed in Catchpole and Slater 2008). Although those songs are not used in the same way that we employ our language, they are learned, rehearsed, and performed in a way that is strikingly similar to how we acquire speech (Catchpole and Slater 2008). Songbirds also have specialized neural circuits that underlie that process, and those circuits are analogous to circuits in the human brain (reviewed in Prather et al. 2017). Therefore, studies of the cells and mechanisms through which songbirds learn to perform their songs may also inform our understanding of the imitative process

through which we acquire the sounds we use in speech.

A study performed using sparrows revealed cells in which activity is closely related to auditory perception. Those cells are very selective in their auditory responses, with robust responses to one song in the bird’s vocal repertoire (Prather et al. 2008, 2009). Those cells are thus among the most selectively responsive sensory neurons ever described. Different cells are responsive to different song types such that the entire vocal repertoire is represented in the population of these cortical neurons (Prather et al. 2008, 2009). Closer examination of the song that is capable of driving a response in each cell reveals that there are highly detailed song features, such as a combination of two notes produced rapidly in a sequence, that are the salient features in driving the auditory response of the cells that are tuned to that song type (Prather et al. 2008). Behavioral studies combined with experimental alteration of the parameters of that salient feature revealed that the cells are not active in association with the specific parameters such as note duration. Instead, the cells are active in association with the bird’s perception of the note (Prather et al. 2009). Those highly selective cells are typically unresponsive to the songs of other birds, but if that salient feature is present in the song of another bird, then they respond (Prather et al. 2008). Thus, each of these cells is selectively responsive to an element of the sounds these birds use in communication.

A breakthrough in our understanding of the possible link between perception and production came when researchers recorded from the same cells described above as the bird performed the salient song feature. They discovered that those cells were as selective in the motor domain as they were in the auditory domain, with each cell being active in association with one song type in the bird’s vocal repertoire (Prather et al. 2008). The key finding was that these cells were active in association with the same song type in each domain, so that each cell was active in association with both perception and production of one and the same vocal behavior (Prather et al. 2008). Each of these cells was active in association with one learned vocal behavior, regardless of whether



that behavior was perceived through the ears or performed through the voice. This colocalized representation of both perception and performance in these cells earned them the name “mirror neurons” (reviewed in Prather et al. 2008, 2017). Because each of these cells is a site where there is a link between perception and performance, they are ideally suited to serve as a mechanism linking those behaviors in imitative learning. Many authors have speculated that this sort of link between perception and performance also underlies human acquisition of language (Lieberman et al. 1967). The discovery of such a mechanism in songbirds provides researchers a context in which to explore the properties of one such link. Discoveries that continue to emerge from studies of neural mechanisms in songbirds will help guide exploration and understanding of corresponding mechanisms in humans, opening the door to development of new mechanistically targeted therapies to ameliorate the challenges of impaired human communication.

### **Communication in Ways Other than Spoken or Written Language**

For some people, such as those who are deaf or otherwise hearing impaired, communication through spoken or written language can be very challenging. In those cases, other forms of linguistic communication are necessary. Languages that incorporate visual-manual communication to convey meaning are known as signed languages. These are complete, natural languages, possessing their own lexicon and grammatical systems in addition to other aspects that are also present in other forms of language (Sandler and Lillo-Marton 2006). Signed languages use a combination of manual articulations to produce the content of a sentence, and they use non-manual elements to convey grammatical function. The patterns of vocal stress and intonation that are used to enhance meaning in a language may not be possible in these contexts, but those forms of prosody are preserved in signed languages through non-manual elements, such as body posture or the movement of the head, eyebrows, eyes, and

mouth. Through the use of non-manual elements such as facial expressions, the speaker can indicate emotional content, such as whether they’re making a statement, asking a question, adding emphasis, or being sarcastic (Liddell 2003).

Signed languages are distinctly separate from other visual-manual communication systems such as “baby sign language” and signs learned by non-human primates. In baby sign language, parents teach hearing babies a small set of signs to facilitate clear and effective communication between parent and baby. This type of signed communication is a form of symbolic support for the development of spoken language rather than the development of a language itself (Fitzpatrick et al. 2014). Humans sometimes teach non-human primates signs to allow them to facilitate communication between those primates and their human caretakers. These cases indicate that non-human primates are capable of forging links between symbols and meaning and thus communicating through signs, but their development of that skill fails to progress into the full grammatical complexity that is characteristic of a complete signed language (Wallman 1992). Thus, although babies and non-human primates can learn to express themselves through signs, they have not been shown to develop their knowledge of a human language as a complete system.

Signed languages should not be confused with body language, though they may appear similar. Body language is a form of non-verbal communication that uses physical behaviors, such as facial expressions, posture, eye contact, and gestures to express emotion or convey information (Pease and Pease 2004). Unlike signed languages, body language lacks a grammar system and can be broadly interpreted, rather than have specific meanings that correspond with specific movements or gestures. As a result, body language is not considered a language in the lexical and grammatical sense, but is central to how we communicate emotional content, and we colloquially refer to it as a language because of its prevalence and its importance in social communication (Waciewicz and Żywicznyński 2010). Culture has a strong influence on how body language is perceived. For example, greeting someone with a firm

handshake can have a different connotation in one culture compared to another. A firm handshake in Western culture is perceived as confident, whereas, in Eastern culture, it is perceived as aggressive (Black 2010). Other gestures can mean the difference between praise and insult, such as giving a thumbs up. In American and European cultures, a thumbs up is a sign of a job well done or understanding; however, in some Middle Eastern cultures, that same gesture would be interpreted as dismissive and a form of insult (Black 2010). Depending on the cultural context in which they are expressed, a range of different behaviors including eye contact, sitting position, and silence can hold an entirely different meaning (Pease and Pease 2004). In contrast, the semantic properties of individual words in a language are much more constant across a similarly wide range of contexts.

Another means through which humans communicate, especially about our emotional status, is music. Similar to language, music has a hierarchical structure that can be broken down into the smallest relevant units of sound, with those units being phonemes in language and individual notes in music (McMullen and Saffran 2004). As in the case of languages, music has “rules,” or a sort of “grammar,” to govern the logic of how individual notes can be used (Mehr et al. 2019; Patel 2008). Notes can be combined into sequences or chords that coalesce to create melodic and harmonic lines of a song. In music, the melody is the main focus of a song, and it serves as a means of communication between composer and audience. A rich variety of information, such as emotional context, can be implied through various aspects of the melody, and harmonies can serve as an additional supporting framework for the melody. In that way, the emotional content and story inherent in the melody can be made richer and fuller by the addition of harmonies into a piece that might otherwise sound hollow and fail to achieve its emotional impact. Through this rich acoustic content, music possesses affect and is thus capable of stirring emotion and conveying meaning.

Because of the prevalence and ability of music to convey emotion across human cultures that speak many different languages, some authors

have referred to music as a “universal language” (Longfellow 1835). Studies seeking to investigate that possibility have revealed that certain features of music, such as pitch or tempo, can be used by listeners of many different cultures to accurately interpret whether a song is about a specific emotion such as love or sadness (Mehr et al. 2019). Those studies also revealed that tonality, referring to the organization of musical pieces around a central note and the relationships between notes and chords that can be used to build or resolve tension, is also widespread (Mehr et al. 2019). These findings point to music as ubiquitous and influential across a range of diverse cultures and musical types, consistent with the idea that it might play some role as a universal form of communication. Experts, however, caution against the colloquial usage of the term “language” to describe music as compared to how it is used to describe spoken and written communication (Jackendoff 2009). For example, the quality and beauty of a piece of music can be quite different for members of different cultures, especially for those that reside in cultures where the tonal content of their local musical style is quite different from that of the piece of music that is played for them (Patel 2008). In that light, the role of music as an artistic means of conveying emotion appears to be broadly conserved across humans, but its role as a means of providing enjoyment appears to be more culturally based rather than holding a universal status.

## Language as a Dynamic Entity Central to Culture

Language is central to human culture, providing a means through which humans are able to express ideas, emotions, and needs. The development and use of language is ubiquitous in human history, as evident in the fact that much of history itself is archived through the use of language. A review of our collective history makes it clear that languages have changed as they have evolved over time, as different cultures have come into contact with one another, and as we have adapted to new needs and opportunities in communication. For example,

humans have developed tools to encode languages in ways that help to increase inclusivity and overcome distances that separate people. One such tool is Braille, which is a tactile writing system of raised dots that can be read with the fingers by those who are visually impaired (Sadato 2005). Braille itself is not a language, but rather a code for language to be written and read. It transforms a previously established alphabet into representative shapes and bumps, with no new grammar or vocabulary. Thus, Braille conveys information through a new representation of already-established letters and words, and therefore it is considered a tool of communication rather than a language all to itself. Similarly, Morse code is a method that encodes text characters as a sequence of dots and dashes (Coe 2003). Codes are transmitted as electrical pulses of varying lengths, often detected as pulses of sound or visual cues such as light flashes. Morse code provided a means of communication that can cross vast distances, eventually giving way to other tools such as the radio, telephone, and television that are so familiar today. As is the case with Braille, Morse code is a change in representation, facilitating communication through already-established languages rather than the emergence of a new language.

History also reveals changes in the prevalence and properties of languages as different cultures have come into contact with one another (Lee 2020). For example, a pidgin is a grammatically simplified means of communication that develops between groups who encounter one another but do not have a shared common language (Lee 2020). The pidgin that emerges from that interaction can serve as a bridge for communication among native speakers of different languages. In some cases, pidgins are then passed onto the next generation of speakers and become a formalized native language with fully developed grammatical and syntactical systems. When a pidgin language has been transformed from a communication bridge to a full-fledged language, it is known as a creole language (Lee 2020). In contrast to pidgins, creoles have a consistent system of grammar, large stable vocabularies, and are learned by children as

their native language, distinguishing them as languages rather than just blends of other languages.

In other instances of interaction between speakers of different languages, their languages have changed more drastically, sometimes becoming either endangered or extinct. Today, there are approximately 7,000 languages in use (Anderson 2012). Some of those languages are experiencing challenges to their prevalence because of younger generations not acquiring them, or because they are spoken by small and dwindling numbers of people, or because they are being used in only certain circumstances, such as family use, but not others, such as commercial use (Lee 2018). These languages are considered to be endangered (Lee 2018). Among these endangered languages are Irish Gaelic, Hawaiian, Louisiana Creole, Zenaga, Bih, many Native American languages, and many other languages spoken in various regions around the world (Eberhard et al. 2020). Their endangered status means that they are vulnerable to loss as a tool of communication and a central element of their associated cultures. In addition to having relatively few current speakers, some of these languages are especially vulnerable to loss because they are primarily or exclusively spoken languages that are not written down and thus have no dictionary, literature, or historical record.

Outside influences such as globalization can contribute to the loss of local languages, as global influence and the demands of commerce can lead members of those cultures to adopt languages that are spoken more broadly. Some languages are spoken so broadly as either a native or a second language that they are considered “world languages.” These include languages that are commonly used in trade and international relations, such as English and French (Eberhard et al. 2020). If speakers of local languages transition to speaking primarily or exclusively those world languages, that can result in local languages being further threatened or perhaps even going extinct, with other languages taking over the role of that lost language in the local culture. If those languages fade away in their usage, cultures can lose an important facet of their identity. In response to such concerns, groups seeking to

preserve cultural history have collected recordings of those speakers and examples of their literature to help preserve the cultural identity of the associated group. Through those efforts, it is hoped that cultural treasures can be preserved that would otherwise be lost as the language in which they are composed becomes increasingly more threatened.

Languages are ever-evolving, living entities that are still changing today. With the emergence of new social trends, language can grow through the introduction and wide incorporation of new slang words. As these words become integrated into wide use, they can eventually be added as formal additions to the dictionaries that define that language. Thus, the vibrant social trends that a language enables are also the engine that can drive its change. This is especially evident in some of the words that have moved from slang to inclusion in canonical dictionaries. For example, the English word “ain’t” is a contraction with many possible usages and meanings, including “am not,” “are not,” “is not,” “have not,” or “has not.” For many years, use of the word “ain’t” was considered incorrect and was discouraged for use beyond casual conversation. This was despite the fact that “ain’t” first appeared in dictionaries in the 1830s. More recently, words like “hangry,” which is a portmanteau of “hungry” and “angry” that describes the feeling of irritability due to hunger, and “vacay,” meaning a form of vacation holiday, have also been added to the dictionary. These examples and many others make it clear that languages are living entities that will continue to grow and adapt as they both drive and respond to changes in human cultures.

## Cross-References

- ▶ [Aves \(birds\)](#)
- ▶ [Cetacean Communication](#)
- ▶ [Communication](#)
- ▶ [Critical Period for Song Learning](#)
- ▶ [Dialects](#)
- ▶ [Georgia State’s Language Research Center](#)
- ▶ [Gestural Communication](#)
- ▶ [Insect Communication](#)

- ▶ [Language Research: Dolphins](#)
- ▶ [Language Research: Great Apes](#)
- ▶ [Language Research: Parrots](#)
- ▶ [Passerine Vocal Communication](#)
- ▶ [Primate Communication](#)
- ▶ [Protolanguage](#)
- ▶ [Referential Communication](#)
- ▶ [Sign Language](#)
- ▶ [Symbolic Communication](#)

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