EDITORIAL

LIMITATIONS OF HUMAN SENSORY SYSTEMS

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All living organisms on earth have sensory systems which help them to detect changes in their environment so that they can respond appropriately to survive, protect themselves or grow. While our senses are incredible tools for perceiving and interacting with the world, they have limitations. Our eyes can only detect a narrow range of the electromagnetic spectrum, we have narrow field of vision and limited visual acuity. Our ears have a limited range of frequencies that they can detect, preventing us from hearing infrasound and ultrasound. We have relatively small number of olfactory receptors. Humans have around 9,000 taste buds, allowing us to detect a wide range of flavours. In contrast, cats have only around 470 taste buds, making them less sensitive to taste. Dogs, on the other hand, have around 1,700 taste buds but their sense of smell is more dominant in determining their food preferences. By understanding these limitations, and knowing about the different mechanisms for enhanced or alternative perception present in other organisms, we can develop technologies and methods to compensate for them and enhance our understanding of the world around us. Inspired by the eye of the morpho butterfly, a surgical camera is developed that connects to the goggles of a surgeon who sees infrared signals given off by tumour-binding dyes and surgeon can remove all of the cancerous tissue.

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All living organisms on earth have sensory systems which help them to detect changes in their environment so that they can respond appropriately to survive, protect themselves or grow. Living organisms on earth are microbes, plants and animals. Microbes, including bacteria and fungi, have evolved various mechanisms to sense and respond to potential threats in their environment. These mechanisms allow them to detect changes in external conditions and develop adaptive responses to survive and thrive.[1] Additionally, microbes can communicate with each other through a process called quorum sensing.[2] Plants have sophisticated sensory systems to detect and respond to light, gravity, temperature, and physical touch. Receptors sense environmental factors and relay the information to effector systems, often through intermediate chemical messengers, to bring about plant responses.[3] Touch me not plant responds to touch and other stimulation by rapidly closing its leaves and drooping.

We discuss here what senses are more powerful in other animals and what senses other animals have in addition to those present in humans. The normal aging process causes gradual losses to the sensory systems. Generally, these changes begin around the age of 50 years. Fortunately, once limitations are recognized and accepted, adjustments or adaptations to the person's environment can help make up for the losses.[4]

Sense of Vision: Our eyes can only detect a narrow range of the electromagnetic spectrum, known as the visible spectrum. We are unable to perceive ultraviolet or infrared light without the aid of technology, although some animals can 'see' with the help of infra-red-light detection. For example, Pit-viper snakes see through two visual mechanisms, i.e., eyes and IR detection mechanism of their pits.[5] Some other animals can also sense the infra-red light, e.g., wolves, dogs, snakes, mosquitos, insects, Vampire bats and bullfrogs. Bullfrogs' eyes adapt to analyze either visible light or infrared light.[6] UV sensitivity is widespread in the animal kingdom. Radiation above 320 and below 400 nm (UVB) can be perceived by many animal species.[7]

Our eyes have a relatively narrow field of vision, with only a small area in the centre called the fovea providing high visual acuity. This means that we often miss important details in our peripheral vision. Horses' eyes are located on the side of their head, so they have a wide range of vision. They can see almost 360 degrees.[8] Owls have a wide visual span of up to 110 degrees, enabling them to spot prey from various angles. Their ability to rotate their heads up to 270 degrees further enhances their visual field.[9]

Another limitation is our visual acuity which refers to the sharpness and clarity of our vision. Humans have excellent visual acuity compared to many other species but some species have visual acuity better than humans. The animal with the sharpest vision is generally agreed to be the peregrine falcon. Scientists estimate that falcon vision is eight times better than humans.[10]

Sense of Hearing: Our ears have a limited range of frequencies that they can detect (20 to 20,000 Hz), preventing us from perceiving sounds below or above a certain frequency. Animals that communicate using infrasonic and ultrasonic sounds are bats, dolphins, dogs, frogs, toads, etc. which communicate via ultrasonic sounds. Rhinos, hippos, elephants, whales, octopuses, pigeons, squid, cuttlefish, cod, Guinea fowl, etc. communicate via infrasonic sounds.[11]

Sense of Smell: Like any other sensory system, the

human sense of smell has its limitations. One limitation is the relatively small number of olfactory receptors humans possess compared to other animals. Humans have around 400 different types of olfactory receptors. The bloodhound is considered to have the sharpest sense of smell among animals. They possess approximately 300 million scent receptors, which is about 40 times more than humans. According to a study published in the journal 'Comparative Biochemistry and Physiology' in 2004, bloodhounds possess more olfactory receptor genes than any other known species.[12]

Sense of Taste: The human sense of taste is a complex and fascinating mechanism that allows us to perceive and enjoy the flavours of various foods and beverages. The sense of taste varies greatly among different animal species. For instance, humans have around 9,000 taste buds, allowing us to detect a wide range of flavours. In contrast, cats have only around 470 taste buds, making them less sensitive to taste. Dogs, on the other hand, have around 1,700 taste buds, but their sense of smell is more dominant in determining their food preferences. Interestingly, some animals, like sharks, have taste buds not only in their mouths but also on their skin, enhancing their ability to detect prey.[13]

Some animals can detect forms of energy invisible to us, like magnetic and electrical fields. We cannot sense the faint electric fields that sharks and platypuses can. We are not privy to the magnetic fields that migrating birds and sea turtles detect. We can't trace the invisible trail of a swimming fish the way a seal can. We can't feel the air currents created by a buzzing fly the way a wandering spider does. Our ears cannot hear the ultrasonic calls of rodents and hummingbirds or the infrasonic calls of elephants and whales. Moths can hear the ultrasonic calls of echolocating bats. Our eyes cannot see the infrared radiation that rattlesnakes detect. Our eyes cannot see the ultraviolet light that the birds and the bees can sense. Arctic reindeer can see ultraviolet light. Many birds like the zebra finch, can see extra colours, their retinas possess four different types of colour-sensing cones. Mosquitos follow the scent of exhaled carbon dioxide.[14,15]

In conclusion, while our senses are incredible tools for perceiving and interacting with the world, they have limitations. By understanding these limitations, and knowing about the different mechanisms for enhanced or alternative perception present in other organisms, we can develop technologies and methods to compensate for them and enhance our understanding of the world around us. Researchers at the University of Illinois and Washington University have developed a surgical camera inspired by the eye of the morpho butterfly. The camera, connected to the goggles a surgeon wears, sees infrared signals given off by tumour-binding dyes so that the surgeon can remove all of the cancerous tissue.[16] Electroreception, magnetoreception, infrared perception, ultraviolet vision and echolocation are some of the senses which are present in some animals but not in humans.

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