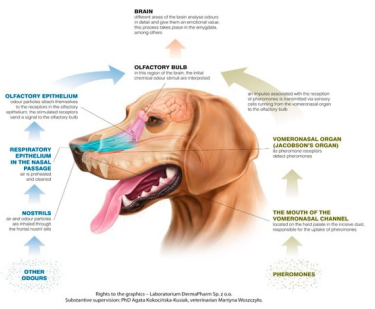
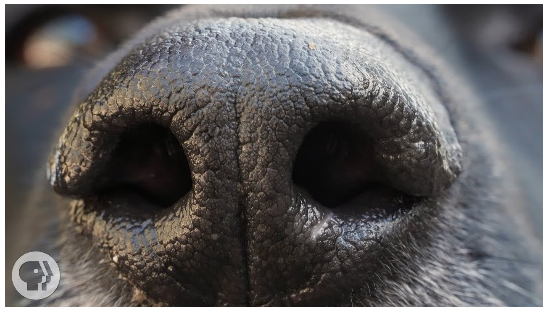
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	犬隻「超級嗅探器」利用氣味來檢測疾病 (Canine "Super-Sniffers" Use Odor to Detect Disease)
生物系統 LIVING SYSTEM	嗅覺系統 (The olfactory system)
功能類別 FUNCTIONS	#感知環境中的化學物質 #感知疾病 #區分來自噪音中的訊號 #Sense Chemicals (Odor, Taste, etc.) From the Environment #Sense Disease in a Living System #Differentiate Signal From Noise
作用機制標題	狗的嗅覺系統透過對受影響個體釋放的化學物質做出反應來檢測疾病和失調 (The olfactory system of a dog detects diseases and disorders by responding to chemicals given off by affected individuals.)
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	 

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

狗有非凡的嗅覺。當它們吸氣時，吸入的少量空氣會進入頭部的一個迷宮般的結構，稱為嗅覺凹處(the olfactory recess)。由於這種結構提供了廣闊的表面積，狗有超過 5 億個細胞可用於感知氣味——大約是人類的 15 倍。這些細胞向神經系統發送訊號的部分稱為嗅球(the olfactory bulb)，其大小是人類嗅球的三倍。

他們的另一個秘密是當狗嗅聞時，它會快速吸氣和呼氣。在呼氣過程中，空氣向下噴射到側面，流動模型顯示這種氣流實際上將狗前面的空氣拉近鼻子，使其能夠從更遠的地方聞到氣味。

這些適應能力使狗能夠對空氣中分子的存在做出敏銳的反應：有些狗可以在數萬億個其他氣味分子中檢測到單個氣味分子。

受患者報告的啟發，他們的狗似乎意識到自己的身體出了問題，並且知道疾病引起的化學變化可以被如此敏感的氣味處理系統檢測到，研究人員訓練狗在檢測到某些化學物質時發出訊號與其中一些疾病有關。

狗可以使用「嗅探測試」來識別患有乳癌的個體，腎疾病、肺癌、糖尿病，甚至 COVID-19。他們還可以利用嗅覺來檢測癲癇患者在癲癇發作時產生的分子。我們不知道這些分子到底是什麼，但科學家認為它們起源於參與癲癇發作的腦細胞，並傳播到汗水、尿液和呼吸中，狗的超級鼻子可以在這些地方捕捉到它們。

Dogs have a remarkable sense of smell. When they sniff, a bit of the air they take in goes to a maze-like structure in their heads called the olfactory recess. Thanks to the extensive surface area this structure offers, dogs have more than half a billion cells available to sense scent—some 15 times what humans have. The part of the nervous system these cells send signals to, called the olfactory bulb, is three times the size of that in humans.
Another one of their secrets is that when a canine sniffs, it rapidly inhales and exhales. During exhalation, air jets downward and out to the side, which flow modeling reveals actually pulls air from in front of the dog closer to its nose, allowing it to sniff scents from farther away.
These adaptations allow a dog to respond to the presence of molecules in the air with exquisite sensitivity: Some dogs can detect a single odor molecule among a trillion others.

Inspired by patients' reports that their dogs seemed to be aware that something was off in their bodies, and knowing that diseases cause chemical changes that could be detected by such a sensitive smell processing system, researchers have trained dogs to signal when they detect certain chemicals associated with some of these diseases.
Dogs can use the "sniff test" to identify individuals with breast cancer, kidney disease, lung cancer, diabetes, and even COVID-19. They also can use their sense of smell to detect molecules that a person with epilepsy produces when he or she is experiencing a seizure. We don't know exactly what these molecules are, but scientists think they originate in brain cells involved in the seizure and travel to sweat, urine, and breath, where dogs' super-noses can pick them up.

文獻引用 (REFERENCES)

這項研究讓訓練有素的狗面對癲癇患者在癲癇發作期間和癲癇發作之外採樣的體味，結果表明，這些狗顯然能夠區分癲癇發作的氣味和同一名患者癲癇發作之外以及所有接受測試的患者的氣味。從第一次試驗開始，他們對「正確」的氣味做出了反應，並且比任何其他氣味都花更長時間探索它。這首次清楚地表明，不同個體和不同類型的癲癇發作確實存在癲癇發作特有的氣味。"（Catala 等人，2019：3）

愛德華茲說："由於癲癇發作樣本來自患有不同類型癲癇發作的患者，因此研究結果表明，狗檢測到的氣味在所有癲癇發作中都很常見。"卡塔拉的團隊指出，能夠概括不同類型的癲癇是一個意想不到但值得歡迎的發現。
癲癇發作是如何從大腦轉變為身體散發出的氣味的？安格爾說，身體會產生標誌性的氣味化學物質，這些化學物質會進入血液，然後進入我們的呼吸、汗水和尿液。他說，SAD 檢測到的癲癇氣味可能反映了癲癇發作期間細胞過程的變化，從而改變了人類發出的氣味。（威靈厄姆 2019）

"This study, in which trained dogs were confronted with bodily odours from epileptic patients sampled during and outside seizures, shows that these dogs were clearly able to discriminate the seizure odours from odours of the same patient outside seizures and for all patients tested. From the first trial on, they responded to the "right" odour and explored it longer than any of the other odours. This clearly demonstrates for the first time that there is indeed a seizure-specific odour across individuals and types of seizures."

“Because the seizure samples were from patients having different kinds of seizures, the findings suggest that the odor the dogs detected is something common among all seizure episodes, says Edwards. Catala’s team noted that being able to generalize across different types of epilepsy was an unexpected but welcome finding.

How does a seizure go from the brain to an odor the body emits? Angle says that the body produces signature odor chemicals that pass into the bloodstream and then into our breath, sweat and urine. The seizure scent that the SADs detected might reflect a change in cell processes during a seizure that in turn alters the odors the person emits, he says.”

參考文獻清單與連結 (REFERENCE LIST) **Harvard 或 APA 格式**

Dogs detect the scent of seizures
Scientific American | March 28, 2019 | Emily Willingham
The Hidden Powers of Animals: Uncovering the Secrets of Nature
February 2, 2021 | Dr. Karl P. N. Shuker

延伸閱讀: Harvard 或 APA 格式（取自 AskNature 原文；若為翻譯者補充，請註明）

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

撰寫/翻譯/編修者與日期

翁書堉翻譯 (2024/3/19)；陳柏宇編修 (2024/11/30)

AskNature 原文連結

https://asknature.org/strategy/nose-sniffs-out-disease/#the-strategy

更多補充的圖片 (1. 確認版權、註明出處 2. 品質: 盡量 72dpi 或 300K)