Taste
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Taste

- Taste receptors in the tongue send information via the 7th and 9th cranial nerves to reach the nucleus of the solitary tract in the hindbrain.

- The nucleus of the solitary tract projects to a specific gustatory nucleus in the thalamus, and from there to the insular cortex.

- The taste receptors in the tongue have only a limited range of perception (salt, sweet, sour, bitter, savory, and piquant) and much of what we call taste is actually based on extra information from our olfactory system.
Smell
Smell (olfaction) plays a critical role in the recognition of predators, partners, and offspring.

- In humans, the olfactory system is less important because of our reliance on a highly developed visual system.

- A great deal of what we call taste is based on olfactory signals.

  - When we have a nasal infection and the olfactory receptors are injured or blocked, we lose about 90% of our ability to appreciate flavors.

  - In rodents, olfactory input to the amygdala can initiate emotional responses, including aggression.
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The olfactory epithelium of the nasal cavity is the site that converts odorant information into coded neural signals.

- **Olfactory receptor neurons** in the roof of the nose are subject to continual damage, and in rodents they have a lifespan of only 40 days.
  - They are constantly replenished from stem cells in the area.

- **An unmyelinated axon** arises from each olfactory receptor neuron.
  - Bundles of these axons travel through holes in the ethmoid bone in the roof of the nose **to reach the olfactory bulb**.
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Many mammals (but not humans) have a second olfactory system concerned with the detection of pheromones.

- Pheromones are odorants that trigger behavioral responses, such as the desire to mate.

- The pheromonesensitive area is called the vomeronasal organ.

- Removal of the vomeronasal organ in juvenile male mice does not impair food-finding abilities, but does impair their ability to recognize sexual signals from potential mates.
Axons of receptor neurons in the vomeronasal organ project exclusively to the accessory olfactory bulb (AOB), which lies adjacent to the main olfactory bulb.

- The output of the accessory olfactory bulb is to a special nucleus superficial to the amygdala, called the bed nucleus of the accessory olfactory tract.
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The olfactory bulb has a complex internal circuitry for processing of olfactory information.

• The fibers projecting from the olfactory bulb mainly travel in the lateral olfactory tract and in the stem of the anterior commissure.

1) The lateral olfactory tract sends fibers to the piriform cortex and other primary olfactory cortical areas.

- In humans, the primary olfactory cortex is located in a region called the uncus at the rostral tip of the temporal lobe.

2) The anterior commissure pathway connects one olfactory bulb to the one of the opposite side.
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*The olfactory ventricle* is a small space filled with cerebrospinal fluid, in the middle of the olfactory bulb.

1) It is formed from *an extension of the lateral ventricle*.

2) In rodents, an area directly under the lateral ventricle, *the subventricular zone (SVZ)*, *produces stem cells* that migrate forward from the lateral ventricle into the olfactory bulb.

- They provide *a continual source of new neurons* for the olfactory system throughout adult life.

- This cell group is called *the rostral migratory stream*. 
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Sensory processing outside the cortex

Conscious perception is just one aspect of sensory function, since the information collected by sensory receptors is registered at many levels in the nervous system.

1. Every sensory axon entering the nervous system gives off collaterals, contacting many other neurons and systems along the way.

2. The cerebral cortex is an important destination for sensory information, but not in every case;

   - In fact, the cortex literally receives sensory information on a ‘need to know’ basis.

   - Many sensory events trigger neural responses without ever reaching the cortex.
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• For example, our blood pressure is continuously monitored by baroreceptors, stimulating receptor neurons whose axons trigger reflexes to adjust heart rate and force, without us ever being aware of our own blood pressure.

• The nervous system of the gut (enteric nervous system, see Chapter 4) has a range of sensors which detect pH and the composition and consistency of gut contents.

• This information is used to adjust bowel contraction and trigger secretions as needed, while the conscious mind remains completely unaware of digestion after food is swallowed.

• However, we are aware of sensory events which are directly relevant to planning and choosing behavior.
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An example: rolling an ankle

• Imagine rolling your ankle while you run, causing an unexpected stretch to the muscles on the lateral side of the calf. The stretch receptors in these muscles fire rapidly, and the information is sent to the spinal cord via the dorsal roots of a lumbar spinal nerve.

• From here, each axon makes synaptic connections with hundreds of reflex circuits in the spinal cord, sending collaterals to pattern generators for walking, running and jumping.

• Finally, the main stem of the axon will travel to the hindbrain to synapse in the dorsal column nuclei.

• From there the second order neuron may send collaterals to brainstem pattern generators, to the cerebellum via the inferior olive, and to midbrain locomotor centers, on its way to synapsing with thalamic neurons, that stimulate the somatosensory cortex.

• The obvious message here is that one signal triggers many synaptic events.
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- The input from the stretch receptors in this one muscle group will help stimulate dozens of reflex adjustments in the spinal cord, helping to activate muscles that stabilize the ankle.

- It will also be used to adjust tension in the muscle itself, and moderate the activity of other muscles which act on the ankle.

- The stretch information will be used to adjust the spinal cord pattern generator regulating running movements, by breaking the stride and allowing time to rebalance.

- Trunk muscles may be activated to shift the center of gravity of the body to help maintain balance.

- Brainstem pattern generators guiding the running may change their activity, slowing down in case of injury or overbalancing.
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• In the cerebellum, information about balance, posture and the position of the body in space will be updated in order to adjust subsequent movements.

• If the runner is in danger of falling, the cerebellum will trigger powerful balance reflexes to correct posture and prevent a fall.

• Most of these reflexes and processing will be triggered before the information reaches the cortex.

• By the time the runner becomes aware of having rolled the ankle, the rest of the nervous system will have made the necessary adjustments, at the same time as dealing with many other sensory events.

• Most of those adjustments will be completely unconscious—handled by nervous system components outside the cortex.
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• The value of conscious perception becomes clear, however, if the ankle roll is severe enough to cause the runner to fall.

• Such an event is outside the range of problems that can be handled by pattern generators and simple reflexes, and requires a more strategic response.

• A serious injury might require rest, and this may also require a strategy to reach somewhere safe to rest.

• Cortical processing is essential to plan remedial actions, like choosing safer ground to walk on, and deciding how much pain to tolerate in order to reach a resting place.
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