The Psychology of the Sense of Smell

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Human olfactory abilities

- Humans traditionally thought to be ‘microsmatic’
  - Species where olfaction (sense of smell) plays a limited role in behaviour

- Based on physiology - small olfactory bulb (OB) in humans
  - Olfaction seen as a “phylogenetically involuted relic” (Broca, 1888)
  - Supported by recent studies on human olfactory receptor (OR) gene loss
OR gene loss

<table>
<thead>
<tr>
<th>Species</th>
<th>OR Gene Loss</th>
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</thead>
<tbody>
<tr>
<td>Domestic dog</td>
<td>18%</td>
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<tr>
<td>Squirrel monkey</td>
<td>18%</td>
</tr>
<tr>
<td>Mouse</td>
<td>20%</td>
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<tr>
<td>Chimps</td>
<td>32%</td>
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<tr>
<td>Gorilla</td>
<td>28%</td>
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<tr>
<td>Orang-utan</td>
<td>32%</td>
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<tr>
<td>Rhesus macaque</td>
<td>36%</td>
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<tr>
<td><strong>Humans</strong></td>
<td><strong>54% - 70% (~60% loss)</strong></td>
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</tbody>
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- **We do have reduced olfactory abilities, but we’ve still retained ~40% of our OR genes (because we use them)**
Human olfactory abilities

• This is now accepted as misleading
  – Human OB highly integrated (Keverne, 1983)
  – Humans can detect thousands of odours
  – Advanced cognitive abilities (Dobb, 1989)

• But... has resulted in much stronger focus on vision and audition for social communication in Psychological research:
  – Verbal communication (language)
  – Perception of body language
Problems with olfaction research

• Odours are invisible
  – Difficult to measure

• Lack of standardised methods:
  – No consensus on how to categorise odours

• Inconsistent findings:
  – Findings are often exploratory (improving)
  – Possible lack of replication (improving)

• Why should we study olfaction at all?
Olfaction in non-human animals

- Olfaction is the primary means of communication in many non-human species

- Influences a variety of social behaviours
  - Recognition of groups and individuals
  - Marking territory
  - Signalling mating characteristics
Human olfactory systems

- **The main olfactory system (MOS)**
  - Mediates what is commonly thought of as odour perception
  - Responsible for the flavours of food and beverages

- **Trigeminal somatosensory system (TSS)**
  - Mediates somatosensory sensations such as a sensation of burning, cooling and tickling
  - Capsaicin in chillis
The Olfactory System

- To thalamus, orbitofrontal cortex
- To hypothalamus
- To amygdala
- Piriform and entorhinal cortex (Primary olfactory cortex)

- Myelin sheath
- To olfactory bulb
- Axons
- Olfactory receptor cell
- Supporting cell
- Cilia of olfactory receptor cells
- Olfactory mucosa
- Turbinate bones
- Tongue
- Olfactory bulb
Olfactory receptor (OR) genes

• OR genes are the basis for the sense of smell
  – Odour molecules bind to the receptors
  – An action potential is generated and sent to the olfactory bulb

• Each OR doesn’t code for a single odour
  – Provide ability to smell lots of odours
  – Odor receptor nerve cells may function like a key-lock system

• Odotope theory
  – Different receptors detect only small pieces of molecules
  – These pieces combined to create a larger olfactory perception (an odour)
Parents and offspring

• Newborn babies learn the specific odours of their mother in the first few hours after birth (Porter & Winberg, 1999)

• Mothers learn the odour of their infant after only 6 hours exposure (Gall & Weisfeld, 2000)

• Most fathers, aunts and grandmothers also learn this odour after 72 hours exposure (Porter et al., 1986)
Human olfactory abilities

• Memory
  – Strong association with childhood memory (Rouby et al., 2002)
  – Linked to emotionally-salient events

• Mood
  – Growing evidence odours can influence mood (Herz, 2009)
  – Environmental odours can effect mood and stress levels (‘hog industry’ odours - Avery et al., 2009)

• Communicating emotions
  – Happiness (Chen & Haviland-Jones, 2000)
  – Fear (Ackerl et al., 2002)

• Attraction (my research field)
Thank you for listening

Quick questions?