



# National University of Singapore

## LSM1303 Animal Behaviour

### Lecture 10: Animal Communication I



Long-tailed macaque and kitten friend.  
Anne Young, 2016.  
Monkey Forest Park in Bali



N. Sivasothi aka Otterman

# Animal Communication I

## Introduction & Chemical Communication

### Scope

- 1. Senders and Receivers
- 2. Diversity of signal use
- 3. Deception, Exploitation and Eavesdroppers
- 4. Human detection of signal transmission in animals
- 5. Chemical communication
- 6. What are pheromones?
- 7. Releaser pheromones
- 8. Primer pheromones
  - 1. Ethyl oleate in honey bees
  - 2. Mice pheromones
- 9. Pheromones in humans

# **Communication in animals: And underlying question**

**How did this evolve?**

- Has communication led to a selective advantage of individuals?

# Animal Communication I

## I. Information transfer between animals: Senders and Receivers



# Communication in animals: Senders and Receivers

For communication to work, there must be  
**Senders and Receivers**

- Sender generates and transmit the signal
- Receiver receives and processes the signal
- The information contained can be deduced by measuring the effect on the behaviour of the receiver (response)

# Communication in animals: Senders and Receivers

- This information is **not random**;
- Communication differs from other forms of information because it involves **signals** sent from one animal to another.
- A signal is a (genetically programmed) product of an animal that has **evolved to carry a specific message** to another animal.

# Communication in animals: Senders and Receivers

- For us to determine function, consider “cause and effect” (objective, not subjective)
  - An action (e.g. an alarm call), results in a reaction (dispersal)
  - Consistent through time and situations

# Overt – Easily understood signals



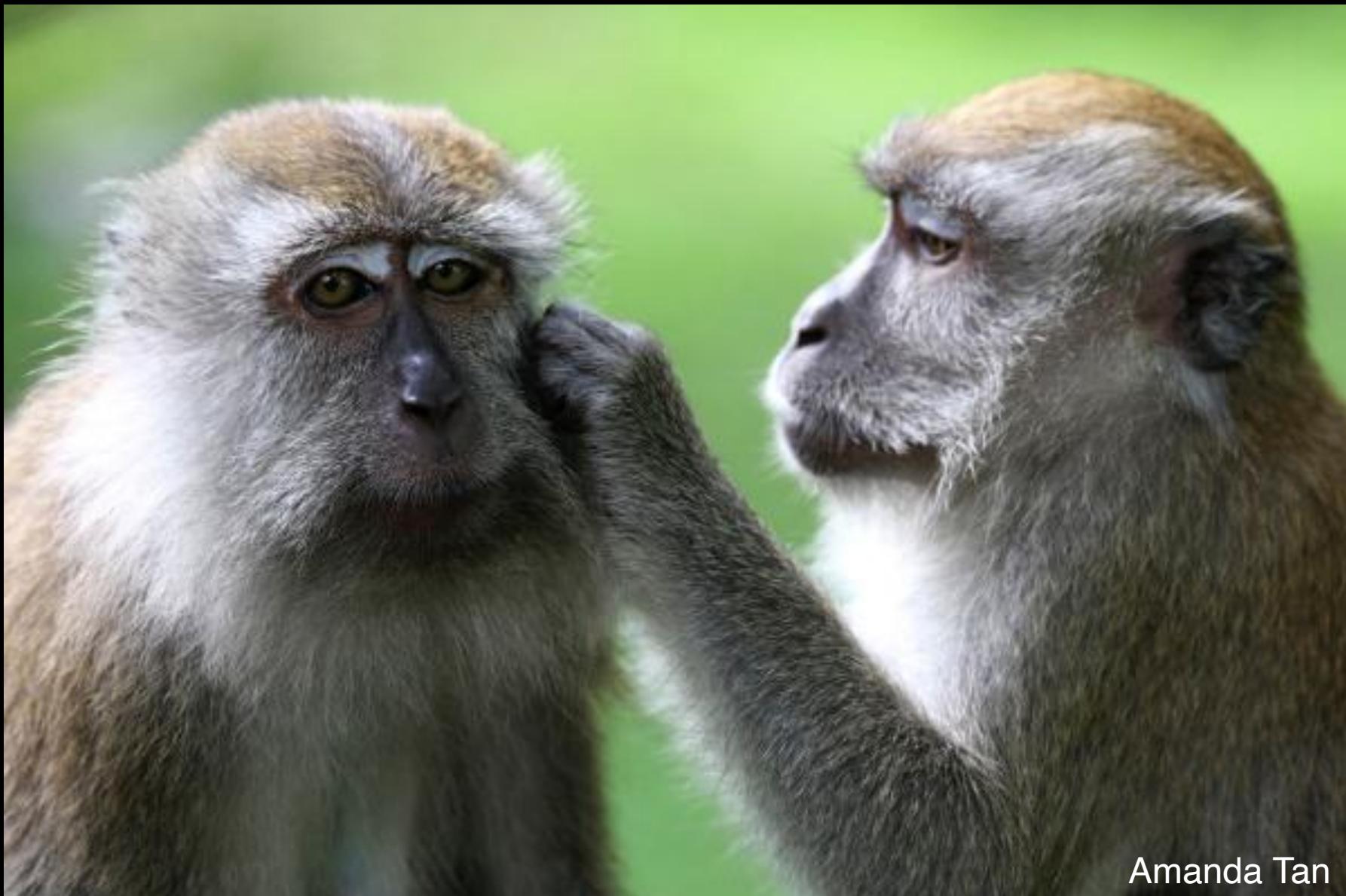
Many signals are understood between species: are you paying attention?



# Animal Communication I

## 2. Diversity of signals

## 2. I A diversity of signals in long-tailed macaques



Amanda Tan

# Communication in animals: diversity of methods

There are a diversity of methods; e.g. with long-tailed macaques communication could include:

- visual (facial expression, body postures),
- auditory (vocalizations),
- physical (grooming, play, mating, aggression)
- and possible chemical (olfactory) signals.

Zeller,A. 1996. The inter-play organisation and facial communication in the macaques. Pp. 527-529 in J Fa, D Lindberg, eds. Evolution and Ecology of Macaque Society. New York: Cambridge University Press.

## 2.2 East African Vervet monkey: a diversity of alarms and grunts



<http://www.africaguide.com>

South Africa

( Wojciech Wronwag )



Signals not as easily observed

## 2.2 East African Vervet monkey: a diversity of alarms and grunts

- Vervet monkeys live in groups
- Vervet monkeys have four confirmed predators: leopards (run to trees) | eagles (look up), pythons (look down) | baboons
- Sightings of each predator species elicits a distinct alarm call [high freq; hard to localise]

Seyfarth, R.M.; D.L Cheney & Peter Marler, 1980. "Vervet Monkey Alarm Calls: Semantic communication in a Free-Ranging Primate". *Animal Behaviour* 28 (4): 1070–1094. doi:10.1016/S0003-3472(80)80097-2.

## 2.2 East African Vervet monkey: a diversity of alarms and grunts

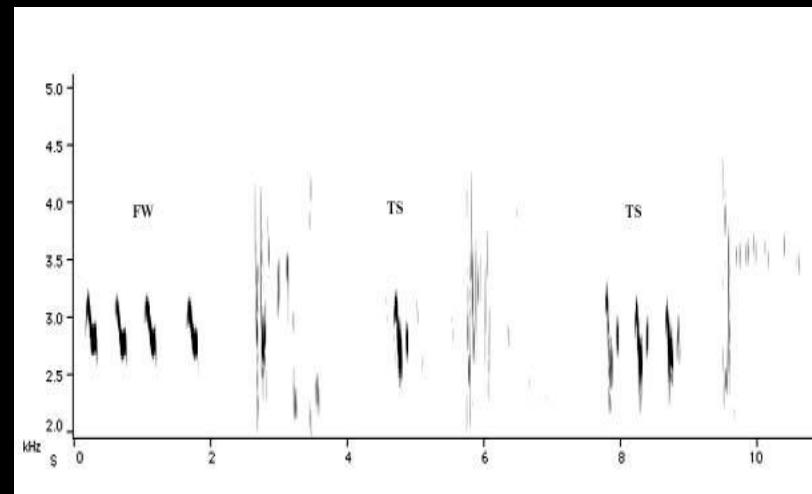
- Harsh sounding grunts appear uniform
- Playback revealed four different calls



## 2.2 East African Vervet monkey: a diversity of alarms and grunts

- Sounds are distinguishable to the animal:
  - approaching a dominant group member
  - approaching a subordinate group members
  - moving into a new range
  - seeing another group

Sonogram of East African  
vervet monkey calls



## 2.3 Communication in animals: How diverse are OUR methods?

- Strangers, relatives
- How does your behaviour vary in
  - a class
  - the canteen
  - when meeting friends

# Animal Communication I

Functions of animal communication

3. Deception, Exploitation  
and Eavesdroppers

# Some functions of animal communication

1. Recognition of species
2. Recognition of individuals
3. Alarm
4. Distress
5. Mate attraction
6. Deception/Exploitation
7. Eavesdropping

# Some functions of animal communication: i) deception

Deception: signallers “deceive” recipients

- White-winged Shrike Tanager (south America) – sentinels signals a “hawk” (tactical deception)
- Flock hides...
- sentinel flies into the open to hunt
- It improves its feeding success at the expense of flock



Samantha Klein

# Some functions of animal communication: ii) exploitation

Exploitation in the Pied Flycatcher  
(*Ficedula hypoleuca*; Europe)

- This species is polygynous, i.e. 1 male is mated to a few females
- Usually is bigamous over distances (200m - 3.5km), and will care for his primary mate
- Older males more successful



# Some functions of animal communication: ii) exploitation

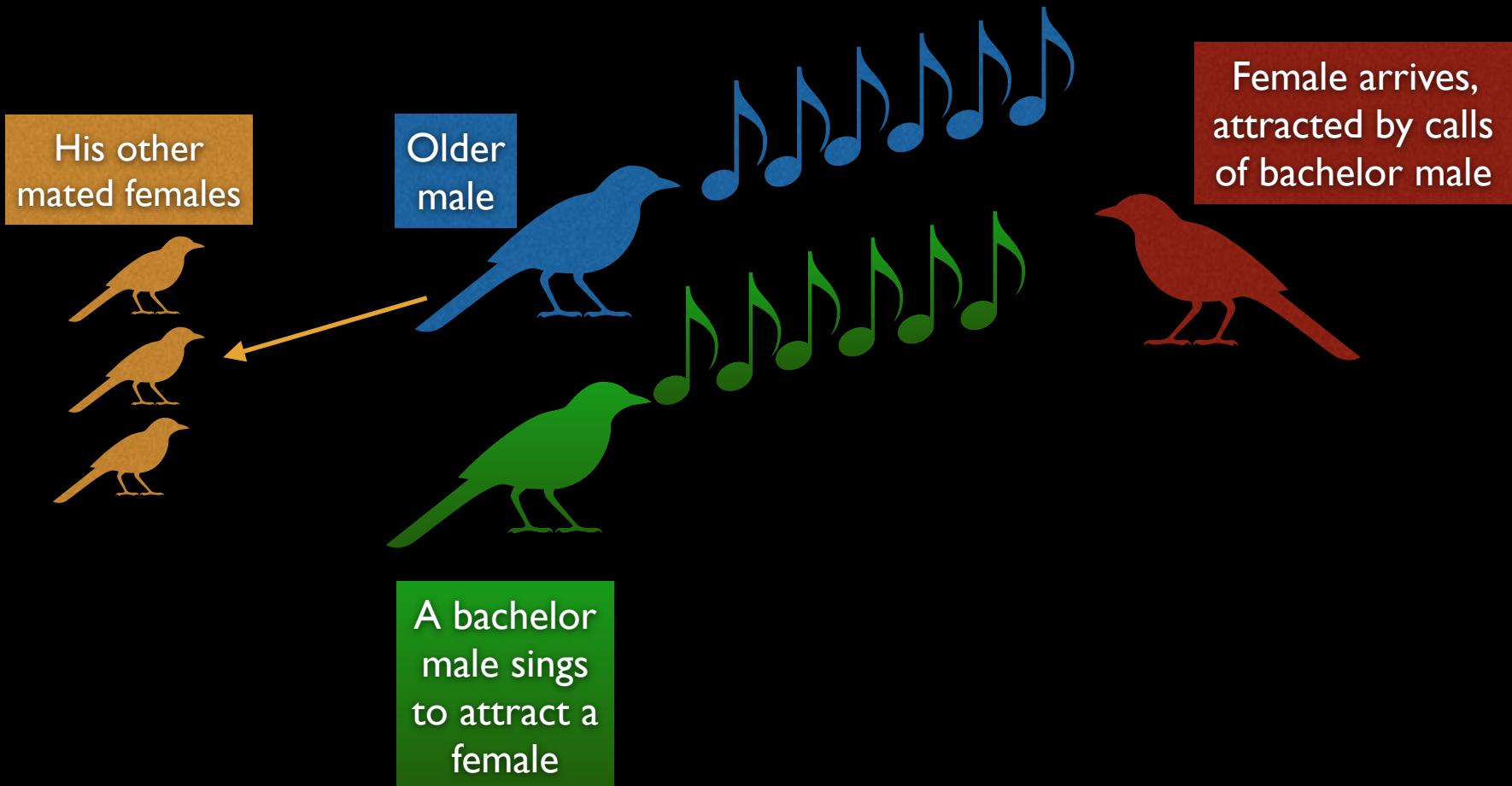
Pied Flycatcher: behaviour of **mated males** (on secondary territory) vs **unmated males**

- When no females are present, mated males sang less
- Exploiting unmated males do the work of initial attraction of females from afar
- When females were present, **mated males sang just as much** as unmated males



# The exploitative Pied Flycatcher

Escalates singing when female appears



## 2. Some functions of animal communication: iii) eavesdropping

6.3 Male cowbirds (*Molothrus ater*; New World) produce calls to attract mates.

A female who chooses a male, responds to his vocalisations with “chattering” calls.



## 2. Some functions of animal communication: iii) eavesdropping

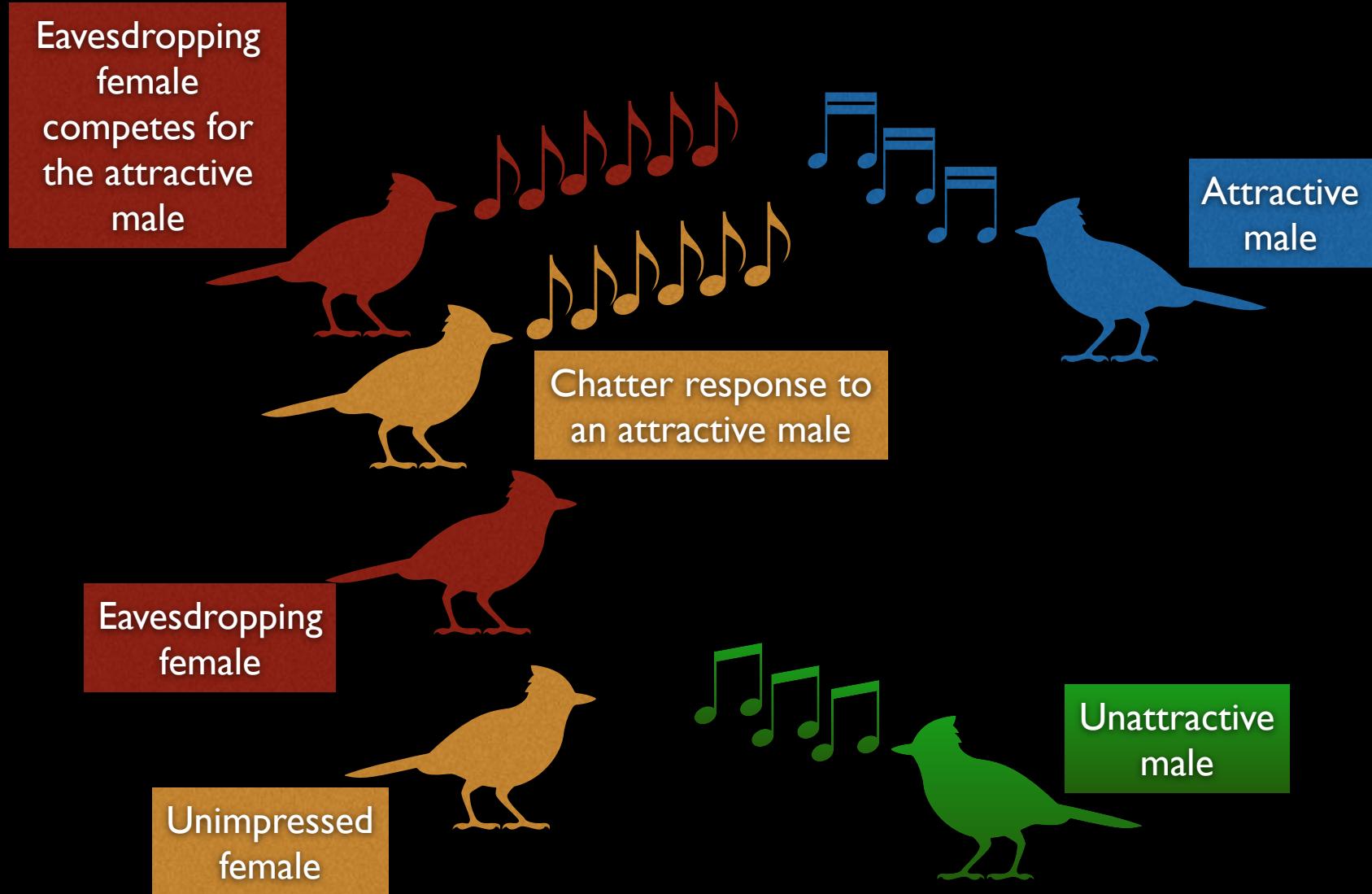


Eavesdropping cowbird females learn to prefer male calls that have already elicited chattering by other females.

The eavesdropper takes advantage of public information to find a high-quality mate

She does not have to assess a large number of males.

# The eavesdropping female cowbird



# Now, let's explore communication in animals...

1. Chemical      This Lecture
2. Audio
3. Visual
4. Tactile

# Parameters affecting communication (how each evolved by natural selection)

1. Range
2. Rate of change
3. Avoid obstacles
4. Ease of locating
5. Energetic cost

# Chemical communication

Characteristics:

1. Information carried over long distances
2. Fade out time longer
3. Visibility not important
4. Get past obstacles
5. Probably the oldest form (bacteria)

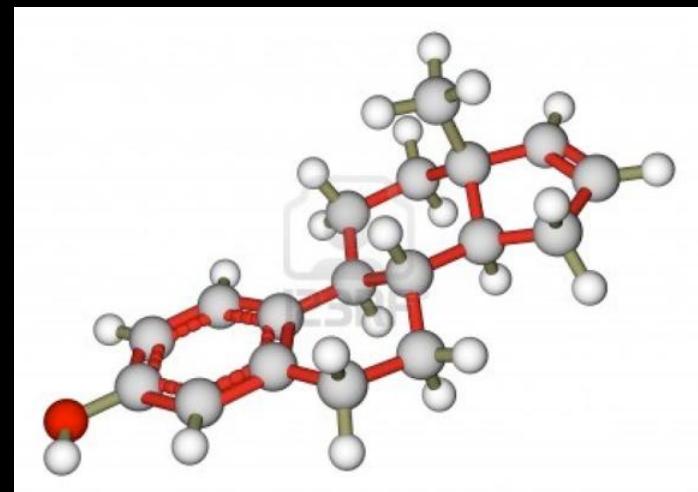
# Animal Communication I: Chemical Communication

4. What are pheromones?

# 4. What are pheromones?

Pheromones are chemicals which convey information.

Most are molecules with carbon chain backbones with **small (light)** to **large (heavy)** molecular sizes.



# 4. What are pheromones?

4.1 Heavy molecule

A **persistent pheromone** (e.g. territorial marking) is more likely to be of a higher molecular weight and relatively more polar.

These require more energy (heat) to evaporate.

Otters use larger, less volatile pheromones to scent mark territories. These **persist** at spraint sites and are more likely to be encountered by other otters.

# Smooth-coated otter spraiting, Marina Bay (2014)





# What signals do I bring back from the forest?



Only after  
forest visits

What  
pheromones are  
out there?

## 4.2 Light molecule

# 4. What are pheromones?

An **airborne pheromone**, (e.g. a moth sex attractant) is likely to be a relative small molecule.

The main alarm pheromone of the honeybee (isopentyl acetate) evaporates almost immediately after release, enabling a rapid defensive response by bee colonies.



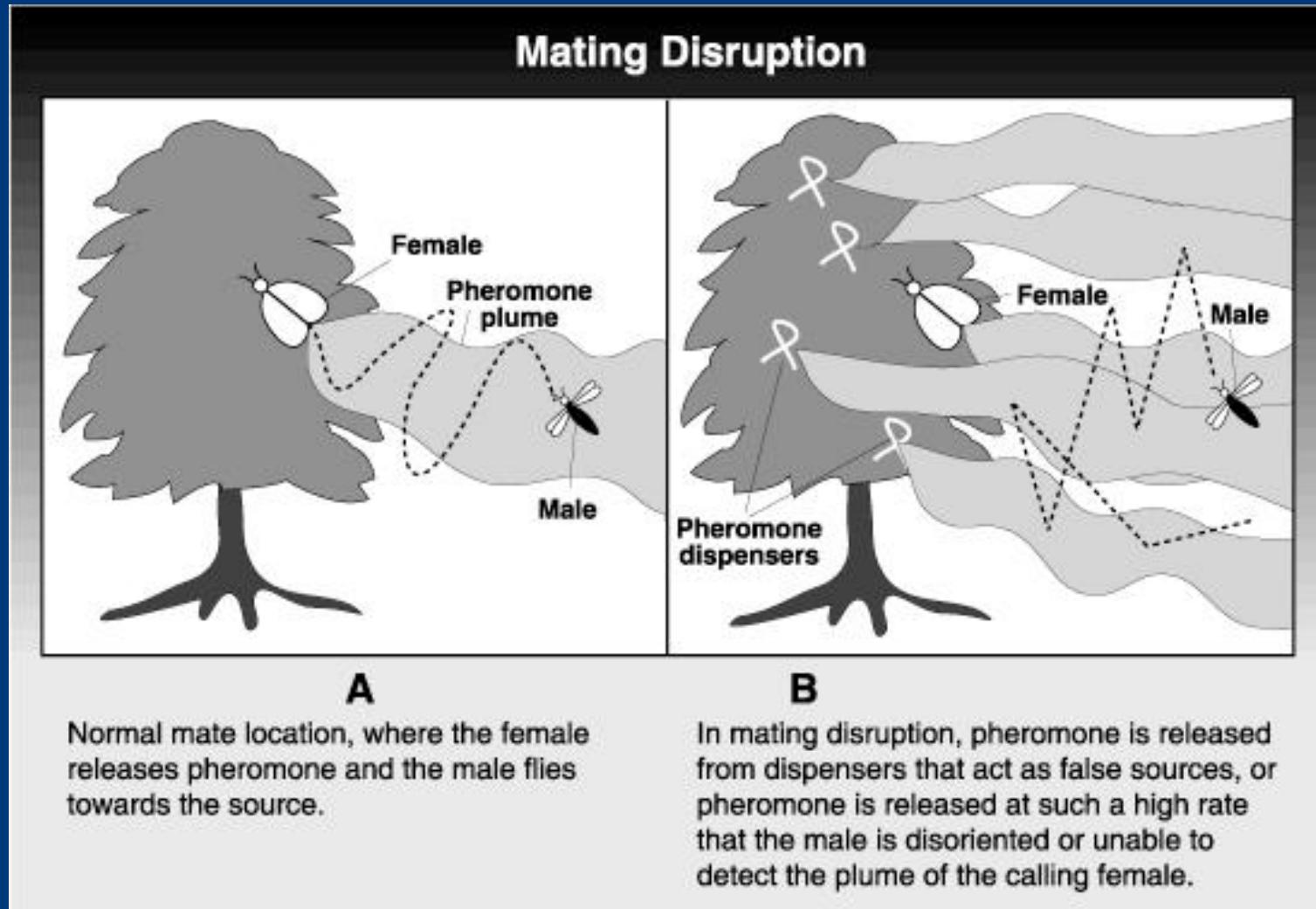
Marcus Ng  
aka Budak

# About the moth sex attractant...



GBB: Cloud forest and flower dome

# Sex pheromone disruption in pest management



# Two types of pheromones

5. Releaser pheromones - immediate  
e.g. Giant Japanese hornet and honey bees alarm
6. Primer pheromones - gradual  
e.g. Honey bees location, laboratory mice and humans

# Animal Communication I: Chemical Communication

## 5. Releaser pheromones

# 5. Releaser pheromones

## Releaser pheromones

have an immediate effect on  
recipient's behaviour.

e.g. bee sting releases alarm  
pheromone - swarming

e.g. alarm pheromone of  
the Asian giant hornet

## 5.1 Releaser pheromones in bees





bee attack

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2008

[HONEYBEES ATTACK HONEYMOONERS IN MYSORE PALACE](#)

Star of Mysore, India - 18 hours ago  
 ACP Rame Gowda visited the hospitals and enquired about the health of the victims of honey-bee attack. Eyewitness accounts told SOM that some pigeons, ...

[Tests show bees in Pascagoula attack not 'killer' strain](#)

Biloxi Sun Herald, USA - Mar 13, 2008  
 Robert Cherry, who was not seriously injured in the bee attack Google past week, said he was relieved the colony was not the so-cal

[South Africa: Vodacom Denies Political Pressure C](#)

AllAfrica.com, Washington - 19 hours ago  
 VODACOM is again insisting there is no political wheeling and empowerment deal, despite a renewed attack from a youth gr

[Emergency bee-attack suit could save lives](#)

Wilson County News, TX - Mar 11, 2008  
 One such product is now being sold out of Falls City — the Bee years, there have been a large number of bee attacks reported

[Agriculture industry bridles at BEE attack](#)

Business Report, South Africa - Mar 9, 2008  
 Sapa reported that she said that black economic empowerment taken into account before firms were allowed to take advantag

[Experts hope 'killer' bee attack is a fluke](#)

Lawrence Journal World, KS - Mar 8, 2008  
 Mississippi — A swarm of thousands, if not hundreds of thousands, of bees 80-year-old man and killed his pet beagle Thursday, and agricultur

# Bee attacks world-wide

bee attack

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Loop News Trinidad and Tobago

**UNC stalwart, farmer dies after bee attack**

United National Congress (UNC) activist and farmer, Dilraj Laloo, 56, died following a bee attack on Friday morning. Laloo was a well-known ...  
 3 days ago



Times of India

**Rajasthan: Honey bee attack kills farmer in Kota**

Rajasthan: Honey bee attack kills farmer in Kota ... Suspecting the farmer had been killed in an attack by honey bees, police lodged a case ...  
 2 days ago



Times of India

**Bee attack stuns visitors to zoo**

Bee attack stuns visitors to zoo ... to Lucknow zoo were taken aback when swarms of honey bees unleashed an attack around 4pm on Tuesday.  
 6 days ago



The twelfth Man Times

**Bee attack stops play for some time during West Indies vs Sri**

...  
 Bee attack in the third ODI · Watch the video below: · West Indies complete a clean sweep.  
 1 week ago



# Bee attacks have occurred in Singapore

# BEE ATTACK

Five beach-goers stung in Sembawang Park; an elderly man and two teens warded, one with more than 100 stings

By KAREN HO

A LEISURELY morning in Sembawang Park turned into a nightmare for five beach-goers yesterday when they were suddenly attacked by bees.

Some of the victims, who included three brothers — Ahmad Shairul, 17, Ahmad Shairil, 15, and Muhammed Hidayat, 13, — were taken to

The duo did the first thing that came to mind: They ran and dived straight into the water, hoping the stinging insects would fly off. They did not. Instead the large swarm headed straight for the boys, stinging them as they screamed and flailed in the water.

Meanwhile, Hidayat was also being chased by the unrelenting swarm.

WTB



**Despite diving into the water,** his brother Shairil could not The insects did not fly off as they attacked the teens as they flailed around in the water.

Shairul was stung more than his face, ears, arms, neck and had about 55 stings. Both were with an 86-year-old man. The Hidayat and a 17-year-old received outpatient treatment.

Police and civil defence officers removed the beehive in a tree (above) and

# Bee attacks have occurred in Singapore

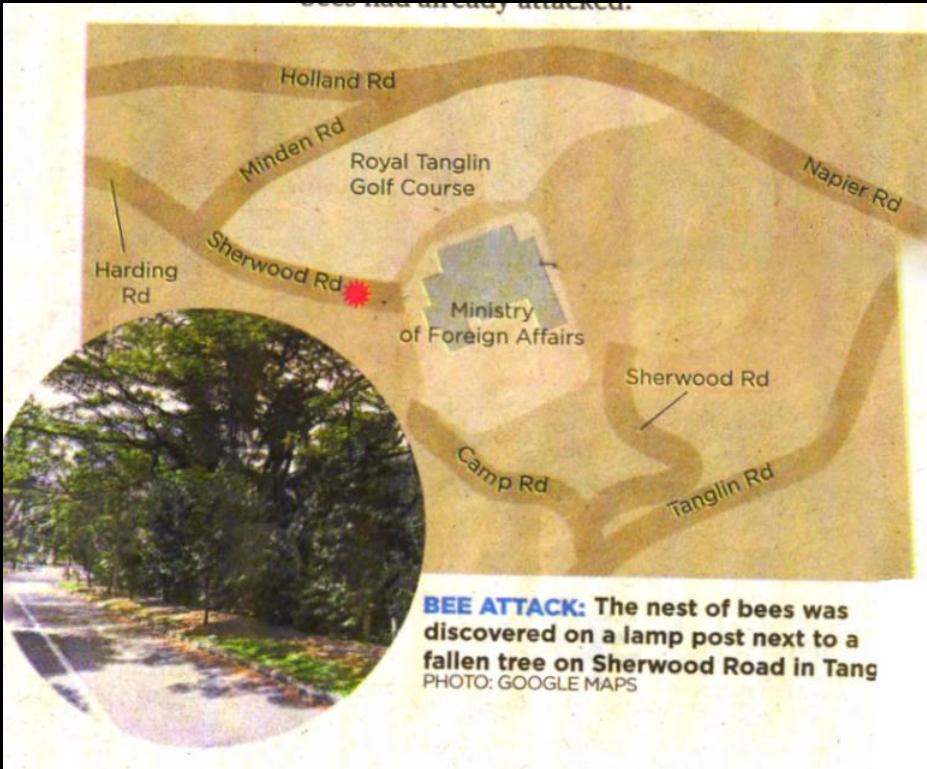
**EXCLUSIVE**  
Pestbusters attacked by  
swarm of bees near Dempsey

**They flee but one of them is stung to death**

PHOTO: ENDINGHEADLINES/INDOPRESS.COM

2 JULIANA JUNE RASUL When will Ryan Gosling be the sexiest man alive? 7

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*[Straits Times Forum](#) 12 Jan 07*

**Some people ignorant of wildlife around them**

Letter from Anthony Lee Mui Yu

*[Straits Times](#) 7 Jan 07*

**Bee attack: Don't fight back, just run**

*[Straits Times Forum](#) 10 Jan 07*

**Snapping shots on mobile phone instead of rendering help first**

Letter from Cho Yan Fatt

*[Channel NewsAsia](#) 5 Jan 07*

**50 students and a teacher attacked by bees in Labrador Park**

By Wong Mun Wai

SINGAPORE: A group of students and a teacher were attacked at Labrador Park by a swarm of bees on Friday. The Singapore Civil Defence Force said they were stung on their necks, arms and legs at about 12.30pm.

The Personnel Decontamination Vehicle was deployed immediately. Paramedics set up a triage to assess the injuries, and 51 casualties – 50 students and one teacher – were sent to two hospitals. – CNA/so

*[Straits Times](#) 7 Jan 07*

**Bee attack: Don't fight back, just run**

Flailing your arms or killing a bee will only provoke the swarm, says pest-control expert By Vincent Leow

CONTRARY to popular belief, if you are being attacked by bees, you should not jump into a pond or a swimming pool. They will just wait for you to emerge. Neither should you retaliate, advises Mr Romaita Abdul Rahim, operations manager of pest control company Pestterminator. Flailing or swinging your arms will only provoke further attack. And do not swat the bees, he added, because the crushed bee will emit a chemical scent that attracts other bees to attack.

*Straits Times* 7 Jan 07

## Bee attack: Don't fight back, just run

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Which is exactly what happened to an elderly woman in one of two bee attack incidents on Friday. She was set upon by a swarm of bees just outside the hawker centre on Zion Road at about 2pm. She tried to swat them away with a towel, but they continued their attack, said finance executive Wee Keng Hor, who wrote in to Stomp, *The Straits Times'* online interactive portal.

What the woman should have done is cover her face and run as quickly and as far away as she could. Bees may pursue for up to 400m. They are slow fliers and most people can outrun a bee. When you are running away, do so in a straight line, protecting your face and avoiding other people, or they too may come under attack. The bees should eventually give up and return to their hive, said Mr Romaita. 'From my experience, I have run for more than 500m before the bees' attack subsided,' he said.

## 5.2 The Asian giant hornet alarm (releaser) pheromone

- i) Pheromones phases
- ii) Mass predation of European honey bees
- iii) Thermal defence by Japanese honey bees



# i) Asian giant hornet – pheromone phases



- The world's largest hornet, *Vespa mandarinia* (Asian giant hornet, 27 – 55 mm length)
- Native to temperate and tropical East Asia, South Asia, mainland Southeast Asia, and parts of the Russian Far East

# i) Asian giant hornet – pheromone phases

1. **Attract** - nest invader releases volatile alarm pheromone to mark prey (e.g. honey bees at their hive).
2. **Attack** - another chemical pheromone spurs an attack by a large group of nest-mates.



Gary Alpert, Wikimedia

## ii) Japanese hornet – mass predation of the European honey bee (1995)



- En masse predation of other social bees and wasps
- A lone foraging hornet rubs around a prey food resource (e.g. honeybee colony)
- Hornet nest-mates congregate and attack marked site en masse!
- Only demonstrated by the giant hornet, *Vespa mandarinia*.

Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

## ii) Japanese hornet – mass predation of the European honey bee (1995)

- 300 Japanese hornets can destroy a nest of 30,000 European honey bees in 3 hours
- Hornets are **5 times larger, armoured,** and the European bees **do not mob** in defence

*These two species did not co-evolve.*

- European honey bees were only recently imported to Japan, i.e. non-native.
- Too recent to have evolved a defense.

Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

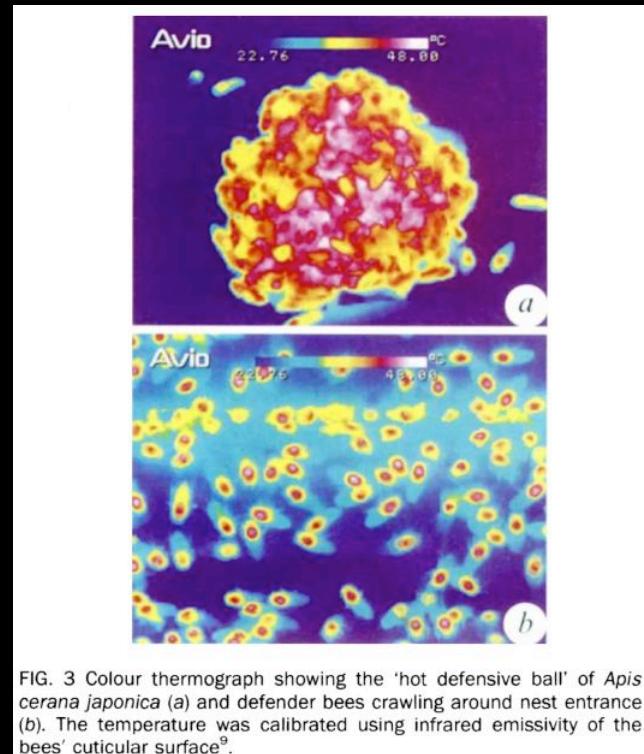
# The Japanese hornet **mass attack** of European honey bees [NatGeo: 4:15]



Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

# The Japanese bee's thermal defense against Japanese hornets (Ono et al., 1995)

- The Japanese honeybee (*Apis cerana japonica*) can detect the hornet marking pheromone, responds by increasing the number of defenders at the nest entrance.
- The invading hornet is captured.
- > 500 other bees quickly engulf the hornet in a ball; temperature is very high (~47 °C)
- Lethal to the hornet but tolerable by bees!



Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

# The Japanese bee's thermal defense against Japanese hornets (Ono et al., 1995)

- Co-evolution
- Win some, lose some.
- This unique defense not seen in the European honey bee.

Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

# The native bees thermal defence against the Japanese hornet [3:05, NatGeo]



Ono, M., Igarashi, T., Ohno, E., & Sasaki, M. (1995). Unusual thermal defence by a honeybee against mass attack by hornets. *Nature*, 377(6547), 334-336.

# Animal Communication I: Chemical Communication

## 6. Primer pheromones

# 6. Primer pheromones

**Primer pheromones** act more slowly by altering physiology and subsequent behaviour of recipient.

Harder to study, thus fewer chemicals known.  
We examine two examples.

# Animal Communication I: Chemical Communication

## 6. I The curious tale of ethyl oleate in honey bees

# About honeybees (Apis sp.)

- \* 20,000 species of bees
- \* < 2% are honey bees (4 - 7 colonial spp)
- \* Center of diversity - Southeast Asia



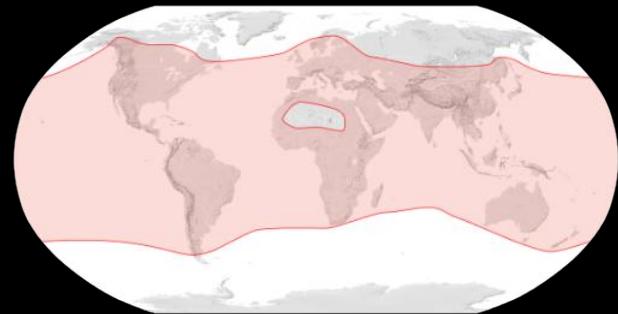
Giant honeybee, *Apis dorsata*  
by Marcus Ng aka Budak



Dwarf honeybee (*Apis andreniformis*)  
Marcus Ng aka Budak

# Western Honeybee (Apis mellifera)

- Apis mellifera domesticated and spread world-wide from Asia or Africa;
- Is known as the western or common honey bee
- Colony = 1 Queen + several thousand workers + few hundred drones (seasonal)





**Drone**

Few hundred



**Queen**

1



**Worker**

10,000s

Richard Lewington

Honeybee (*Apis* sp.) queen is the only reproducing female in the colony



# Western Honey bee (*Apis mellifera*)

- Single hive - 60,000 individuals
- Roles:
  - Queen,
  - drones (males) - reproduction.
  - Workers (females) - 'housekeeping'
    - Nurse, younger
    - Forager, older



foraging honey bee



honey bee in flight  
carrying pollen on leg



bee hives set up  
for pollination -  
critical in  
agriculture

# Worker bees - two kinds

1. Nurse bees (younger) - nurse larvae in nests (~first 21 days)
2. Forager bees (older) - collect food and defend the colony (final 1-3 weeks of a 5-week life span)

# Worker bees - two kinds

- \* The cohesion and distribution of tasks in the hive is controlled mainly by pheromone blends.
- \* A balance between the two populations is maintained – nurer bee maturation rate is dependent on worker-worker contacts

Mouth to mouth transfer of food between  
foragers and the younger nuser bees –  
*trophallaxis*: food exchange that also serves as a  
communication channel



Zachary  
Huang

# A chemical was involved!

- Ethyl oleate is a major component of a primer pheromone produced by foragers when they ingest floral nectar fermented by yeast
- It is chemical inhibitory factor for maturation of nurses

Leoncini, I., Le Conte, Y., Costagliola, G., Plettner, E., Toth, A. L., Wang, M., ... & Robinson, G. E. (2004). Regulation of behavioral maturation by a primer pheromone produced by adult worker honey bees. *Proceedings of the National Academy of Sciences*, 101(50), 17559-17564.

# Ethyl oleate in honey bees: Social work force distribution

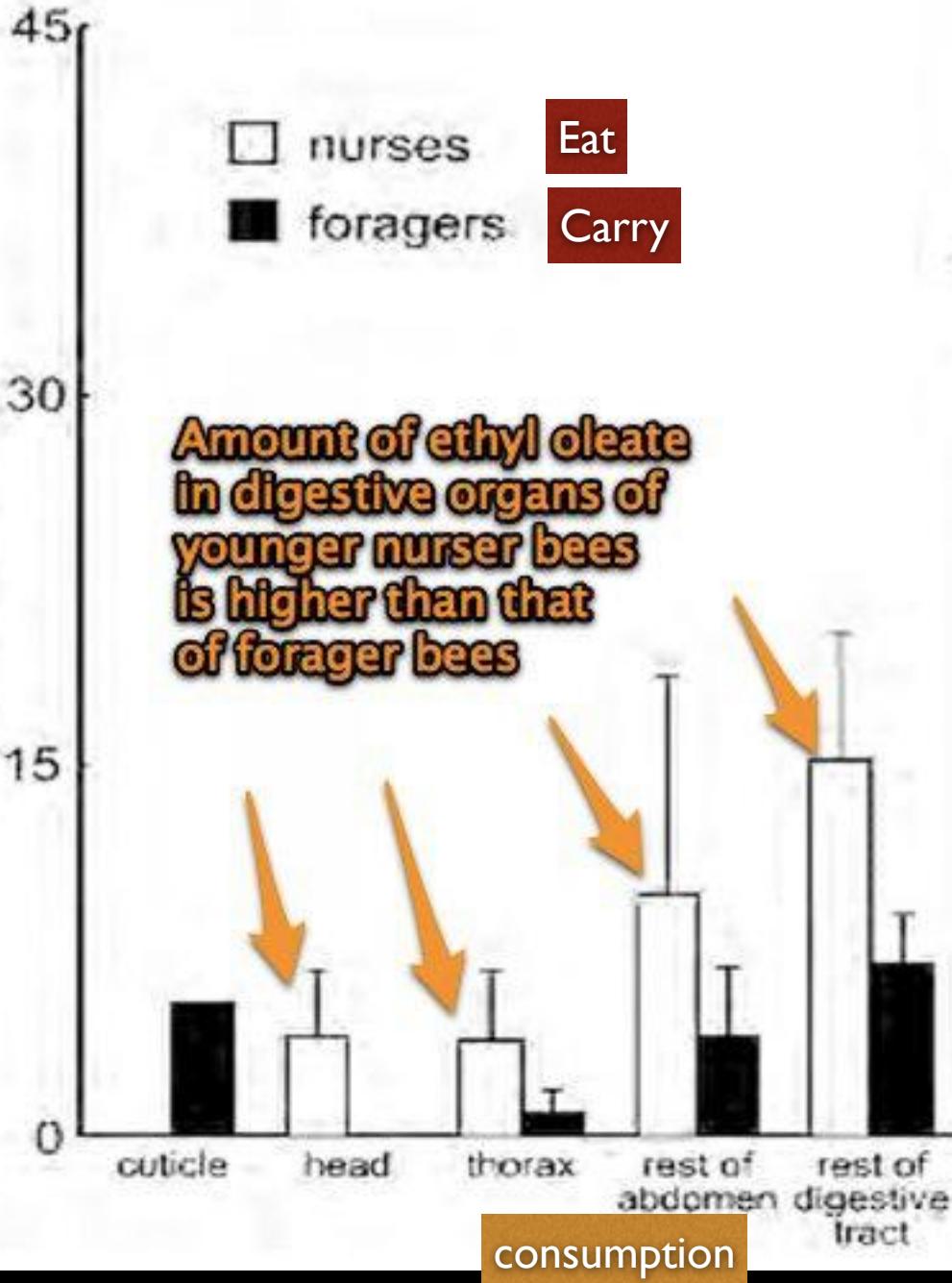
- If older bees were confined more than normal (e.g. extended rain),
  - ==> fewer young bees would mature.
- If the number of non-returning older forager bees was significant,
  - ==> young nurse bees would mature earlier and become foragers.

# Ethyl oleate in honey bees: Social work force distribution

- Forager bees synthesise ethyl oleate when gathering food, regurgitate but don't digest it.
- Ethyl oleate gathers externally on the head, exoskeleton and abdominal reservoir where they store nectar.

Castillo, C., Chen, H., Graves, C., Maisonnasse, A., Le Conte, Y. & Plettner, E. (2012).  
Biosynthesis of ethyl oleate, a primer pheromone, in the honey bee (*Apis mellifera L.*),  
*Insect Biochemistry and Molecular Biology*, 42 (6) 416.

Ethyl oleate (ng/bee)



Where is ethyl oleate in honey bees located?

# Ethyl oleate in honey bees (2004)

- The **forager bees** feed the chemical to the **worker bees** (trophallaxis).
- Ethyl oleate keeps them in a ‘teenage state’ - slows down worker maturation rate by several days.



# Ethyl oleate in honey bees (2004)

- As the **old bees** die off, the chemical no longer is fed to **nurse bees** (no more inhibition).
- The '**young**' bees mature into **foragers**.

*FYI, there is more to this: there are also primer effects of brood pheromone and queen mandibular pheromone.*

# Bug-sniffing dogs to work in California vineyards

Posted Mar 3rd 2006 6:01PM by [Deidre Woollard](#)

Filed under: [Wine](#)

I've heard of bomb-sniffing and drug-sniffing dogs before but now [Decanter reports](#) that bug-sniffing dogs are being used by California winemakers. Golden retrievers are being trained to sniff out the vine mealybug which causes massive grape vine destruction. Vinters have raised \$33,000 to train puppies at the Assistance Dog Institute. The dogs will bark where they detect the mealybug sex pheromone.



[Read Permalink](#) | [Email this](#) | [Linking Blogs](#) | [Comments](#)

[1]

Not just bees,  
dogs can sniff  
out insects too

## HIGHLIGHTS

- It is said that you can't teach an old dog new tricks, but Cliff Lede winemaker Michelle Edwards has taught her bloodhound to sniff out TCA.
- Edwards' hound, Miss Louisa Belle, inspects small batches of corks when they arrive at the winery.
- Bloodhounds are an ideal breed for TCA-sniffing duty, thanks to their powerful sense of smell and focused personalities.



Miss Louisa Belle can detect  
2, 4, 6-trichloroanisole (TCA);  
Wines & Vines, Aug 2006

Corked wine containing TCA has an odour described as resembling a wet dog or damp cloth.  
Airborne fungi convert chlorophenol compounds into chlorinated anisole derivatives.

# Animal Communication I: Chemical Communication

## 6.2 Of mice and pheromones



The Secret Chemical  
World of the Lab  
Mouse

Source: “Making sense of scents: reducing aggression and uncontrolled variation in laboratory mice.”

- By Professor Jane Hurst, Mammalian Behaviour & Evolution, University of Liverpool. NC3Rs #2 Mouse scents and optimal husbandry; Sept 2005.
- National Centre for Replacement, Refinement and Reduction of Animals in Research.



# The Secret Chemical World of the Lab Mouse

Laboratory mouse - use of scent

- Dominant male maintains territory
  - Suffuse territory with scent
  - Countermark and attack competitors
  - If does not defend territory and scent of competitors detected, then it will be challenged



# Of mice and pheromones

## Subordinate males

- After repeated defeats, reduce pheromone concentration in urine (do not provoke)
- Reduce (not stop) scent marking
  - Must maintain, familiarity
- No longer attractive to females



# Of mice and pheromones

## Female choice

- attracted by volatile pheromones in male urine,
- prefers males with exclusive scent-marked territory,
- Or successfully counter-marked competitors
- Dissimilar scent!



# Of mice and pheromones

## Reproductive priming events

- Novel adult males can
  - accelerate juvenile female puberty
  - induce oestrus in adult female
  - terminate pregnancy, induce oestrus



# Of mice and pheromones

## Reproductive priming events (cont'd)

- Effect of **novel adult males** on females is moderated by
  - Social dominance - accelerates
  - Males that lose fights - lose effect
  - Castrated males - no effect



# Of mice and pheromones

## Reproductive inhibiting events

- Non-breeding Females (>3) can delay puberty in juvenile females
- Can induce pseudo-pregnancy in adult female



# Of mice and pheromones

Laboratory mice – a balance between many factors to promote harmony!



# Of mice and pheromones

## Laboratory mouse welfare

- Important for husbandry, lab maintenance
- welfare and research
- Keep mice in social groups!

# Of mice and pheromones

## Avoid male aggression in lab mice

- ❖ Separate dominants
- ❖ Watch unfamiliar
- ❖ Introduce in neutral, no scent setting
- ❖ Avoid female scent  
(even on the clothes of a lab worker)
- ❖ Not complete removal of soil bedding  
(subordinates may become unfamiliar)
- ❖ Avoid prolonged single housing

Think about captive  
management in other  
animals

Communication, but also habitat use,  
sounds, light, colours, etc

# Animal Communication I: Chemical Communication

## 7. Pheromones in humans

- Synchronicity in human female oestrus?
- Menstrual synchronicity in humans
  - Stern, K. & M. K. McClintock, 1998. Regulation of ovulation by human pheromones. *Nature* 392, 177-179.

# Underarm compounds in women can alter the reproductive cycles of other women (Stern & McClintock, 1998)

- Source: 9 women, pads worn under armpits, 8-hours, before and at ovulation
- Applied to: 20 women, 2 months - pads rubbed above upper lip

Source of odorless compound	Effect
Early in menstrual cycle	Lengthened cycle
Late in menstrual cycle	Shortened cycle

# Menstrual synchrony in a sample of working women

Wellera et al., 1999.

- 51 pairs of working women
- been together for at least 1 year,
- shared a relatively small office, worked there all day full time
- contact with other people during the day was minimal.
  - Menstrual onsets of close friends: within 3.5–4.3 days of each other
  - Onsets of co-workers, not close friends: 7.7–9.0 days of each other

Zhengwei Yang & Jeffrey C. Schank.  
Women Do Not Synchronize  
Their Menstrual Cycles

Human Nature, 17(4): 434-447.

So likely untrue  
but people like the idea

# Women temporarily synchronize their menstrual cycles with the luminance and gravimetric cycles of the Moon

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## Abstract

Many species synchronize reproductive behavior with a particular phase of the lunar cycle to increase reproductive success. In humans, a lunar influence on reproductive behavior remains controversial, although the human menstrual cycle has a period close to that of the lunar cycle. Here, we analyzed long-term menstrual recordings of individual women with distinct methods for biological rhythm analysis. We show that women's menstrual cycles with a period longer than 27 days were intermittently synchronous with the Moon's luminance and/or gravimetric cycles. With age and upon exposure to artificial nocturnal light, menstrual cycles shortened and lost this synchrony. We hypothesize that in ancient times, human reproductive behavior was synchronous with the Moon but that our modern lifestyles have changed reproductive physiology and behavior.

# Pheromones in humans



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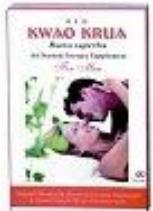
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