

LB144-Pandemic  
*2022 edition*





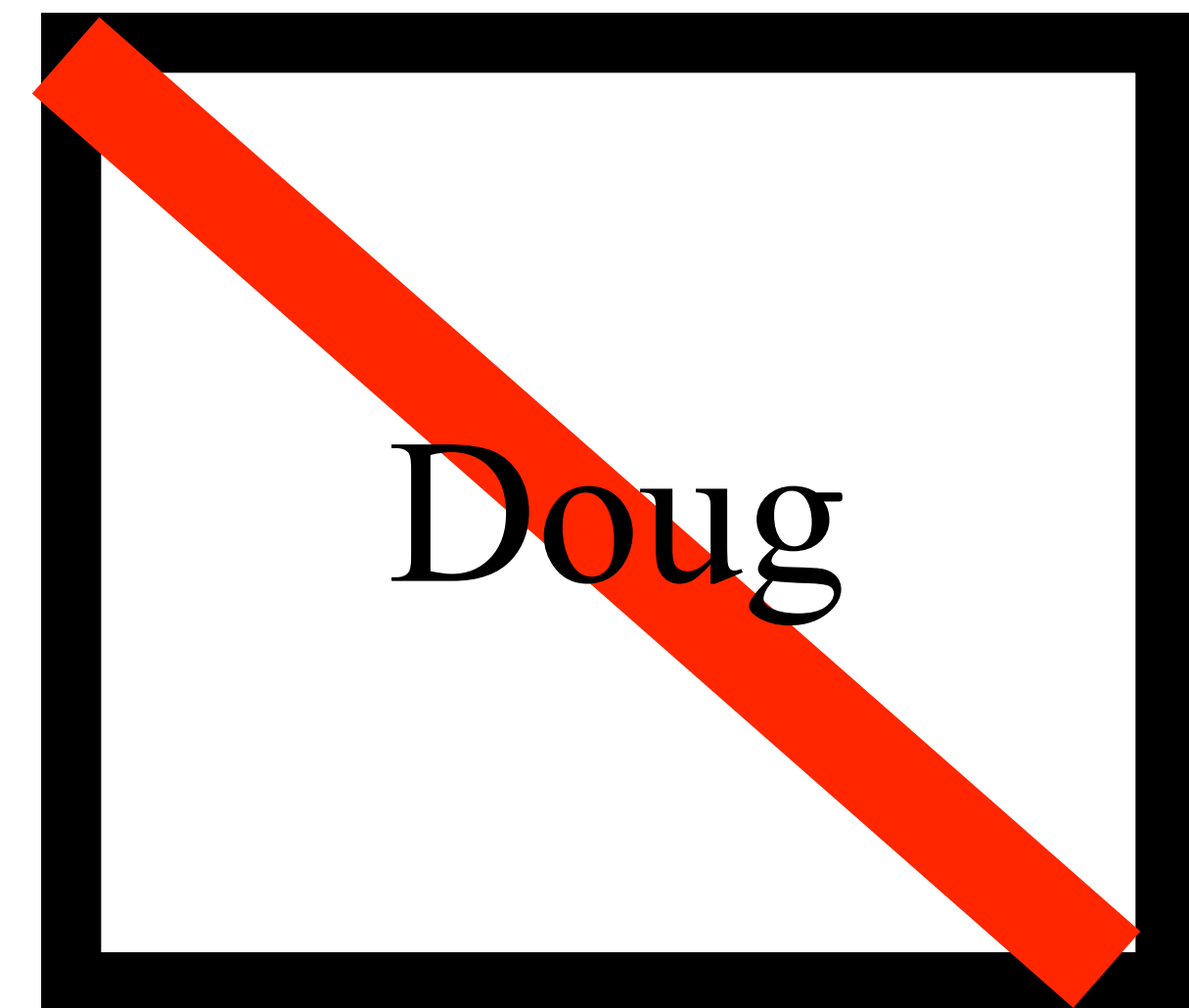
# 1. Clicker Attendance

- Launch your Top Hat app on your smart phone, or load the TopHat.com website, or text to the course phone number.

# 2. Sit with your group in lecture & lab

# 3. To Opt-OUT of being called upon

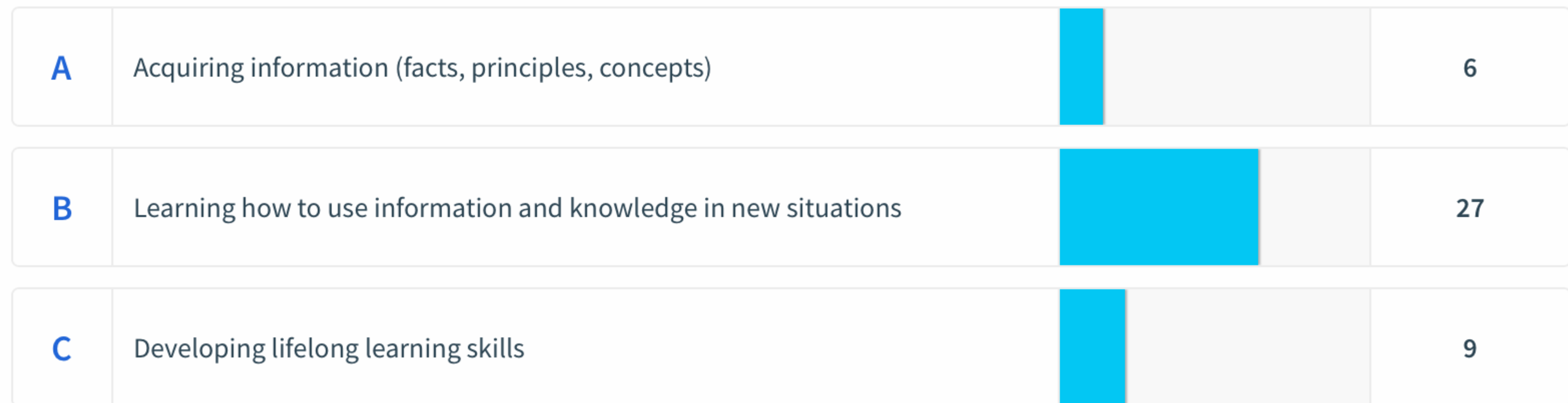
- Name Card with red stripe means you Opt-OUT (can Opt-OUT 3 times)





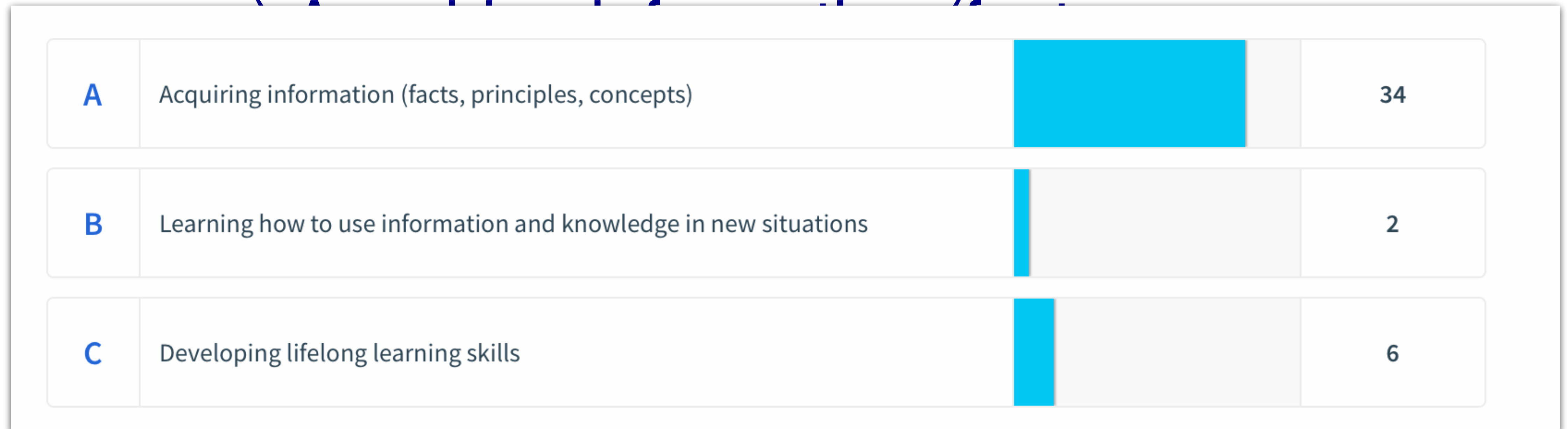
Thinking of what you want to get out of your college education and this course, which of the following is **most important to you?**

a) Acquiring information (facts, principles, concepts)





Of these three goals, which one do you think you can make headway on **outside of class** by your own reading and studying?

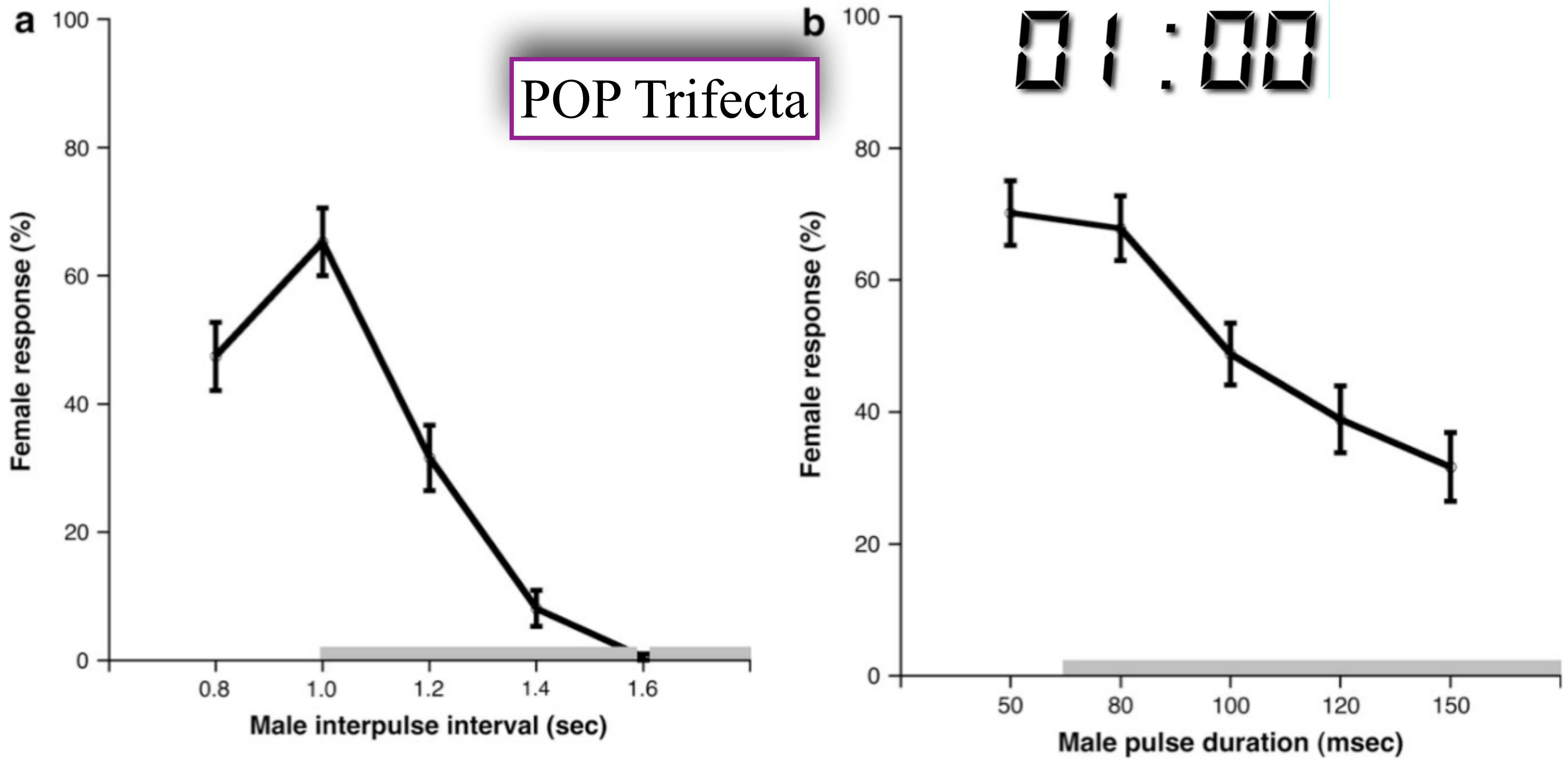




# The Science of Summer - Fireflies with Dr. Sara Lewis







**Figure 4**  
 Preference functions of *Photinus greeni* females to simulated male signals presented in a latin square design in laboratory tests conducted at 70°F–72°F. Each female was presented with 20 flash



01:00

## Student performance on concept inventory (Pre, Mid, Post)

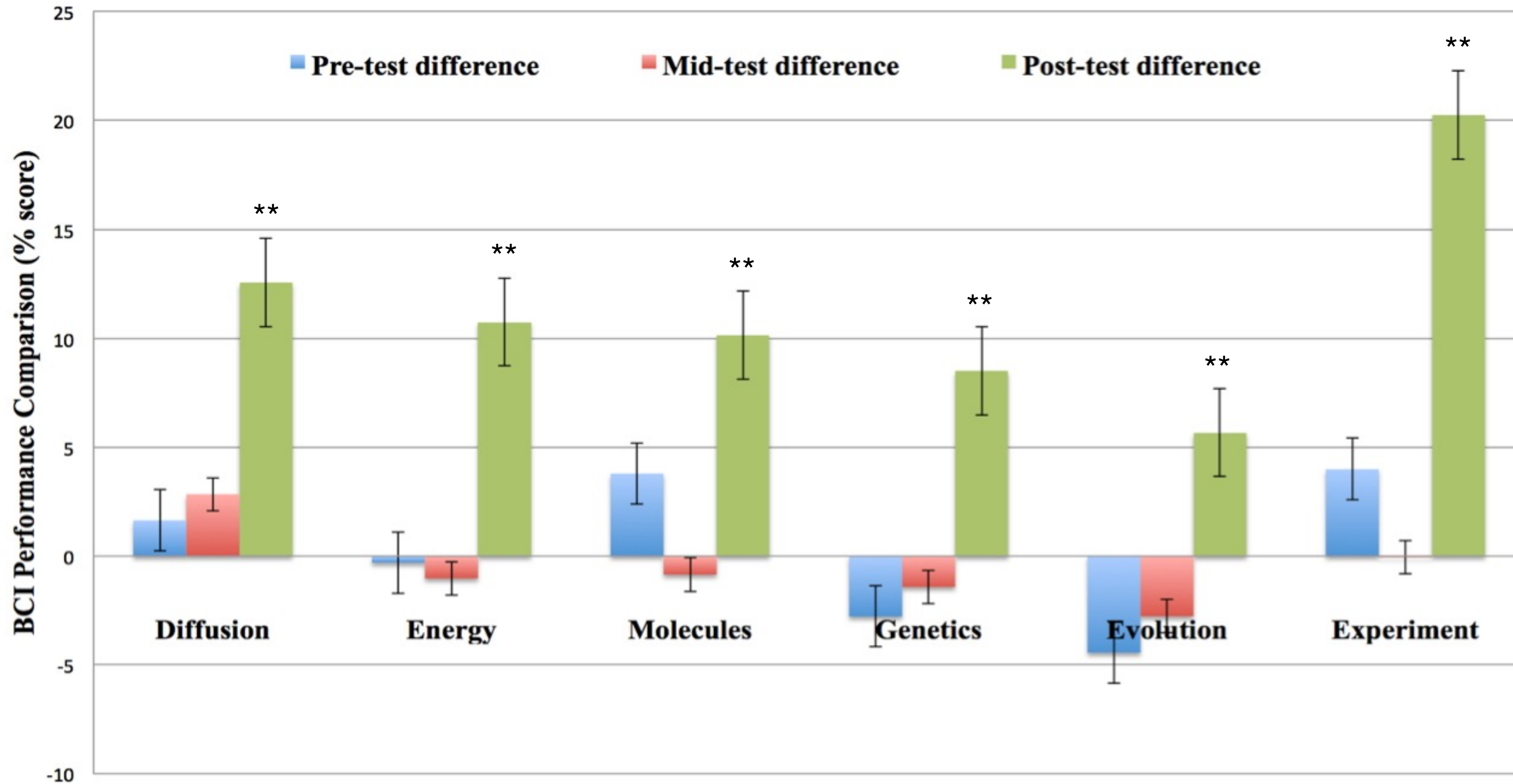


Figure 1: ACT-normalized performance of ICB textbook students (n=76) versus controls (n=98) in LB144 & 145 on biology concept inventory test developed (BCI) by Klymkowsky et al 2009 (SEM; \*\*p<0.01).



1. Name one communication behavior exhibited by fireflies

2. List one cost and one benefit associated with that behavior



# Announcements

1. FYI: Contracts? Sketch figures in notes so can recognize on exams.
2. Yesterday you got feedback for your talk four times, the feedback is focused upon “how to communicate effectively” in a Presentation as well as guidance about Human, Gene, professional Methods should be used etc.
3. OFFER: Any group may ReDo talk without using TARDIS.
4. Sharing TopHat attendance code to students not present is a breach of Academic Honesty.
5. **The Monday Journal Club “JClub” is where you learn how to read papers better and inadvertently write better papers.** Next week we tackle Lindsay Harrington and Katharina Fabricius’s paper on Coral settlement.
6. **Next week in lab your group’s “2-paragraph Proposal” Paper is due at start of lab period.** You are expected to have a complete semester-long plan, with full methods from pubs, but will tweak/improve you plan as you go.
7. **In 10 days first EXAM occurs in-person, here on \*Monday\* JClub day.** Can bring 3x5” index card with notes. Must also know all the research papers to get higher than 3.0. Are you preparing now, so you won’t stress then?



# Stand-up

if working hard for 3.5 or 4.0 in the *lecture course*

## **Remain standing if...**

1. Attended all classes & completed all readings
2. Have taken thorough handwritten notes on all
3. Have written IQ answers & already studied them

3.5-level: Wrote out Trifecta answers & review before class

4-level: Have attempted to read the research papers of Ulagaraj & Walker (crickets), Ryan & Page (bats), Sara Lewis (fireflies), Katharina Fabricius (corals), Vincent Bretagnolle (petrels)

**Budgeting homework time (70 min):** In Ch. 17, section 17.2 (the second half of on **birds**) is 2378 words in length. Technically this should take 12 minutes if you just read it. But when done properly, when you pause to review all of the data figures and tables, read and think about a few of the Integrating & Review Questions, and take careful notes, this assignment should take you more like 70 minutes (if you are focused). **Special Allowance:** Your group can divide up the Trifectas for this lecture.

1. \_\_\_\_\_ **For Thursday's lecture**, slowly read the second half of section 17.2 titled "More complex communication in a bird" (on storm petrels) and take handwritten notes.
2. \_\_\_\_\_ **Answer some Integrating Question and Review Questions.** As you read the ICB textbook always attempt to answer at least one of the yellow **Integrating Questions** each time you get to a set of them. Also try to answer the green Review questions.
3. \_\_\_\_\_ (Trifecta): **Prepare to explain (aloud) Figures 17.6, 17.7 and Tables 17.1, 17.2, 17.3 in class** (Purpose, Methods, Findings)

**\* Special Allowance today\*:** If you wish, your group can designate who will be responsible for each figure or table and thus split up the responsibility and reduce the load.



## Reading

- Exam →
- o Papers read so far:
1. Crickets - Ulagaraj - Walker 1973
  2. frogs v. opossums Tuttle - Ryan 1981
  3. corals - Lindsay Harrington + Katharina Fabricius 2004
  4. fireflies - Sara Lewis 2006 + James Lloyd 1969
- o Movies: Albert Uy *Islands of Creation* Talkin' to Shangus  
 Attenborough *Tachinid flies* - Fowler 1984  
*learning in bats* - Page + Ryan 2006

## 17.2 (Part 2 - Storm Petrels)

How is information transmitted between members of animals species

Bottom line: Signals from one → responses in receiver of same species

- LD.s • Describe functions of info exchange • Explain how communicate
- Evaluate cost vs benefits of signalling • Interpret data from playback observations

Nobel Prize: Konrad Lorenz - studied social goose communications visual auditory  
 To communicate is heritable, but data in communications is not.

"More complex communication in a bird" <sup>reminds us of:</sup> Albert Uy *Monarch flycatcher birds* Solomon Islands

Firefly language is simple + limited, vocalizations of birds → more variety  
 Acoustic signals for more than just finding a mate. Also use visual signals.

Wilson's Storm Petrels - 'storm' hide at ships during storms, Petrel - St. Peter  
 come to land only in breeding season → nests → many birds - loud! on colony <sup>walk on water</sup>  
 Kerguelen Islands

Fig 17.6 | Sonograms Vincent Bretagnolle 1989 (Fig 1) Indian Ocean

Purpose: Record native calls, archive full range of vocalizations

Methods: Place microphones at two locations - mouth of burrow - away from burrow  
 Capture, observe, organize, visualize as sonograms (MSU site) No Cet

Findings: Named, hypothesized, evaluated sonograms (syllables)  
 Male Petrels → 2 "chattering" calls outside burrow + grating call

IQs: Describe calls 17.6 + differences. How similar to firefly?

## 17.2 Storm Petrels (cont)

1989

In addition to recording calls Bretagnolle recorded context.  
 Where was "Male caller", where was "receiver", sex/gender of receiver  
 (in/out burrow) (overhead? / face to face)

Tables 17.1 + 17.2 - data organized + compared

17.1 (A) - data 17.1 (B)  $\chi^2$  statistical test results

17.2 Male vs male (vs) Male to Female comparisons

Purpose Tables 17.1 + 17.2 Study #1 (continued)

• Compare situations/contexts and statistical tests to look for significance

Methods: Audio recordings (as mentioned, check paper)  
 with observations to provide context where, who, gender<sup>sex</sup>

Findings: Male alone → chattering or chattering/grating - advertise? self  
 (at by burrow) (talking aloud) to females  
 Male facing other bird → grating call defense vs male? recruit vs female  
 vs males

Study #2 Bretagnolle Playback

Fig 17.7 | Purpose: Decode language  
 test response to calls to ID function/meaning

Methods: recorded vocalizations → speakers near colony near burrow entrance  
 "like game Marco Polo" via replication build evidence  
 Observe + record response of bird (repeat) audio responses visual  
 Over 20 days performed many trials. Responses → no sex/gender data

Direct flight = \_\_\_\_\_ circle flight = \_\_\_\_\_ landed = \_\_\_\_\_

Playback recordings were: chattering, grating, mix, no calls

Findings: Gender recognition  
 Males talk/chatter + grating #1 but females don't ("chat her up")  
 ("chat may attract females")

Males + Females both talk with grating call #2  
 Note very noisy plus if "attached" females may not respond



## Section 17.2: How is information transmitted between members of animal species?

### **Biology Learning Objectives**

- Describe the function/purpose of communication and information transfer between organisms.
- Explain how animals communicate and find each other through the use of different signals.
- Evaluate costs and benefits of signaling using light and/or sound.
- Interpret playback experiments used to decode signals sent between members of the same species.



# CALLS OF WILSON'S STORM PETREL: FUNCTIONS, INDIVIDUAL AND SEXUAL RECOGNITIONS, AND GEOGRAPHIC VARIATION

by

VINCENT BRETAGNOLLE<sup>1)</sup>

(Centre d'Etudes Biologiques des Animaux Sauvages, C.N.R.S.,  
Beauvoir-sur-Niort, 79360, France)

(With 2 Figures)  
(Acc. 31-III-1989)

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## Introduction

Most of the burrowing petrels are nocturnal on their breeding colonies, and the vocal activity appears therefore to be of prime importance for reproduction (STOREY, 1984) and pair-establishment (JAMES, 1985). Visual signals are thought to be secondary compared to vocal ones, especially in mate attraction and burrow defence (BROOKE, 1986). Mutual displays are entirely vocal, though a possible use of olfactory signals cannot be rejected (GRUBB, 1974). The functions of mutual displays have been summarized as i) advertisement, ii) synchronization of activities for breeding, and iii) species and sex recognition (HUNT,

# A population of birds and information transfer between individuals

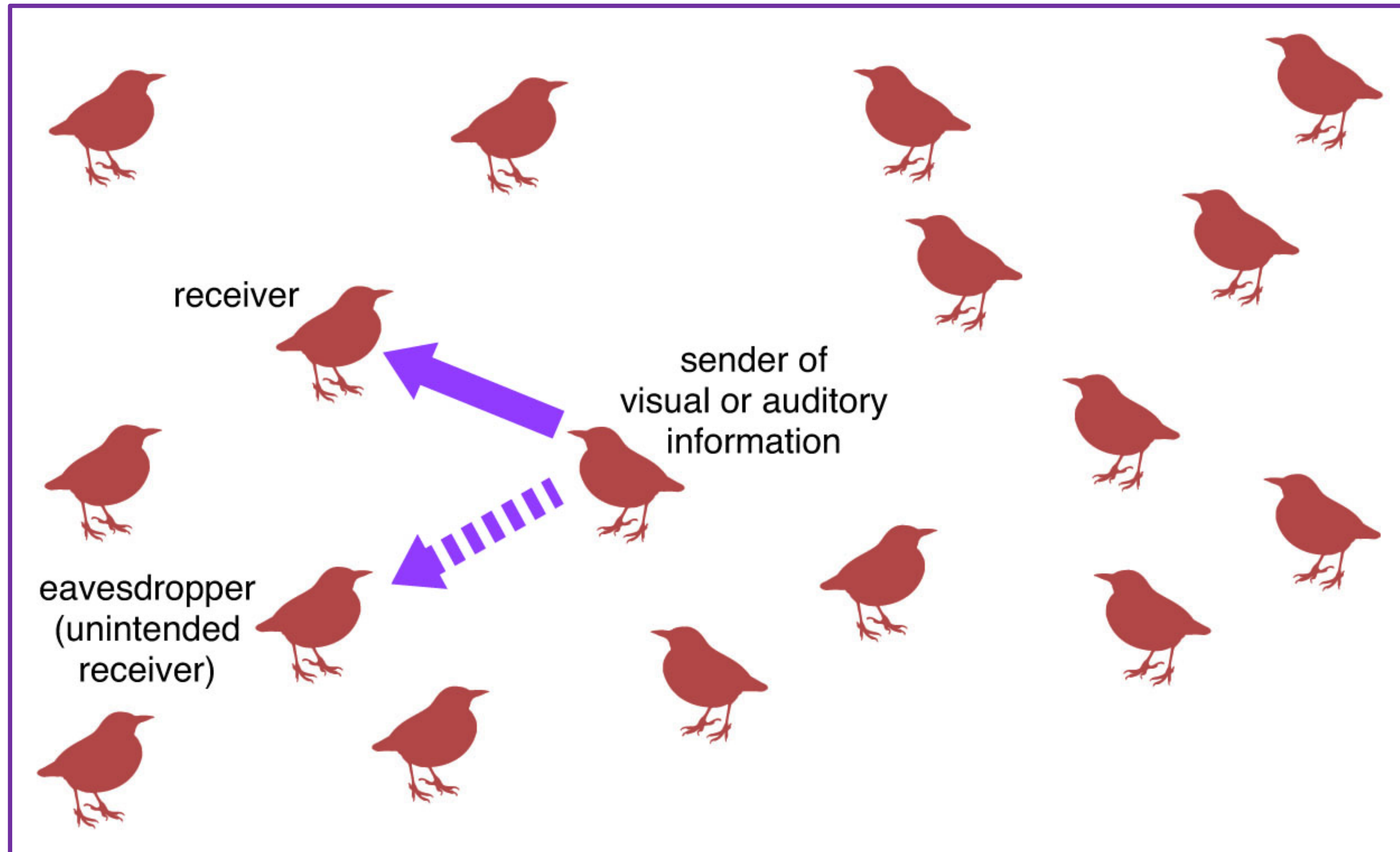


Figure 17.1



# Wilson's storm petrel (*Oceanites oceanicus*)

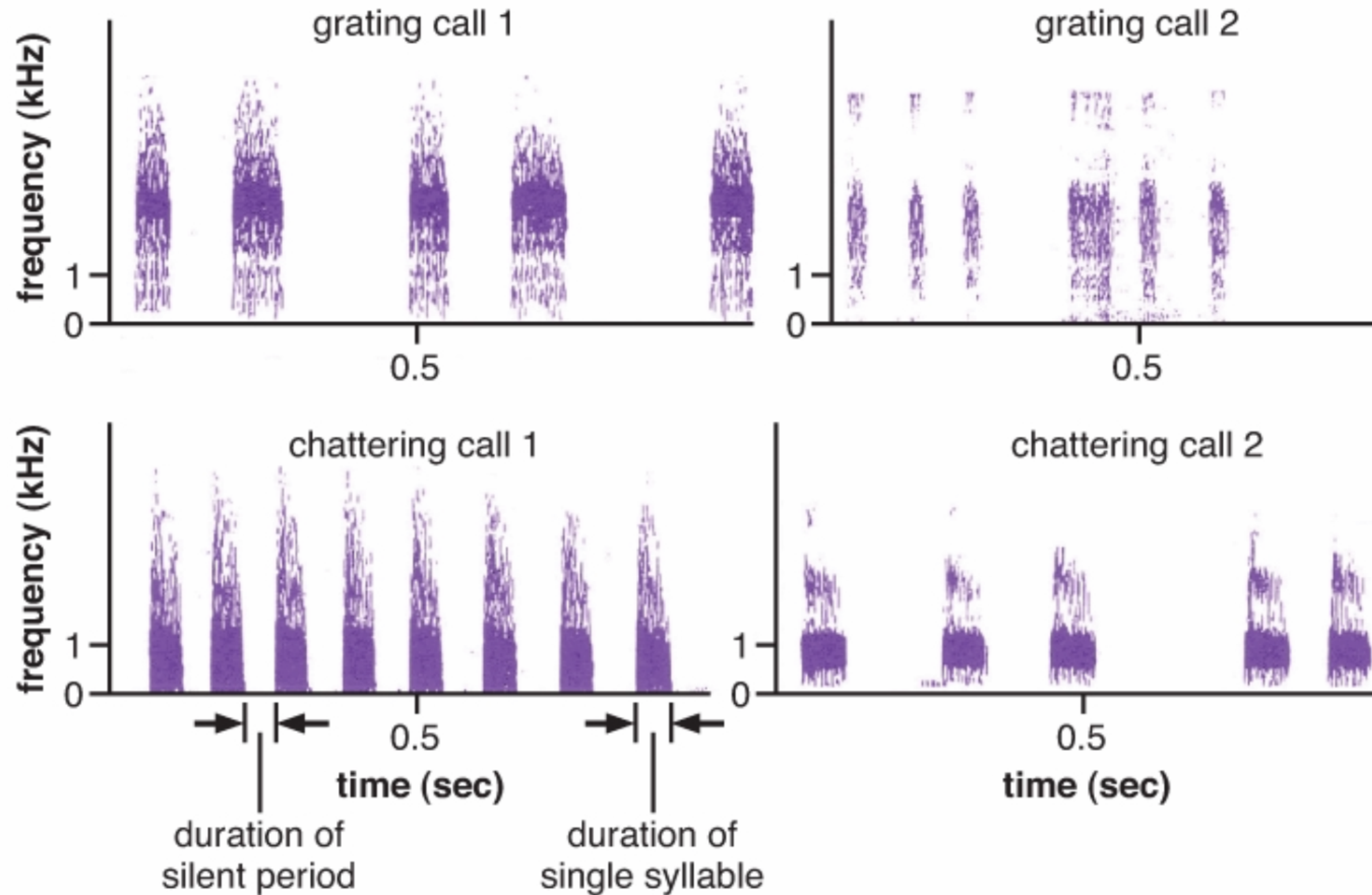


Why are they called storm petrels?

Figure 4.7



# Trifecta?



## Random call

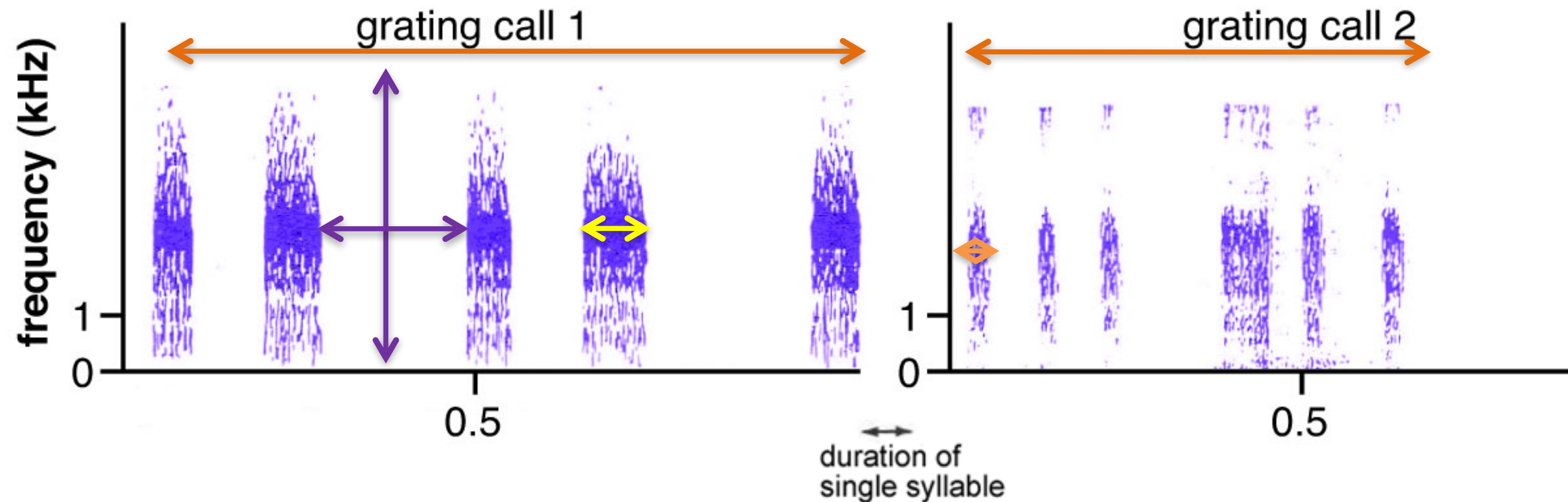
**Figure 17.6** Sonograms of Wilson's storm petrel acoustic signals on the Kerguelen Islands in the southern Indian Ocean. Syllables are periods of sound, which are separated by silence (blank spaces). Modified from Bretagnolle, 1989, Figure 1, reprinted with permission from Koninklijke Brill NV.



# Describe the grating calls of Wilson's storm petrel

**Explain:** 1) Who makes which calls and from where?

2) How calls vary. 3) How this figure is analogous to fireflies



Characteristics of calls include duration of call, number and pattern of syllables, duration of silences, and frequency of syllables

# Trifecta?

situation of the bird	call uttered		
	chattering	chattering and grating	grating
bird alone ( $n = 96$ )	38	35	23
flown over by another bird ( $n = 69$ )	33	18	18
facing another bird ( $n = 95$ )	9	16	70

**A**

compared situations	$\chi^2$	p-value
alone vs. flown over	2.05	0.36
flown over vs. facing another	41.5	$1 \times 10^{-9}$
alone vs. facing another	48.7	$2 \times 10^{-11}$

**B**

**Table 17.1** Comparison of when male Wilson's storm petrels make particular calls. **A**, Frequency of calls in different situations and **(B)** chi-squared ( $\chi^2$ ) comparison of frequencies (see [Bio-Math Exploration 17.2](#)).

Modified from Bretagnolle, 1989, Table 4. Reprinted with permission from Koninklijke Brill NV.

type of interaction	grating call 1	grating call 2	$\chi^2$	p-value
male/male ( $n = 45$ )	29	16	24.3	$8.25 \times 10^{-7}$
male/female ( $n = 37$ )	4	33		

**Table 17.2** Frequencies of types of grating calls made by males when involved either in male-male or in male-female interactions. Modified from Bretagnolle, 1989, Table 5. Reprinted with permission from Koninklijke Brill NV.

**Random call**



# Trifecta?

What major differences in frequencies do you observe, are they significant?

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	chattering	chattering and grating	grating
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**Random call**

# Trifecta?

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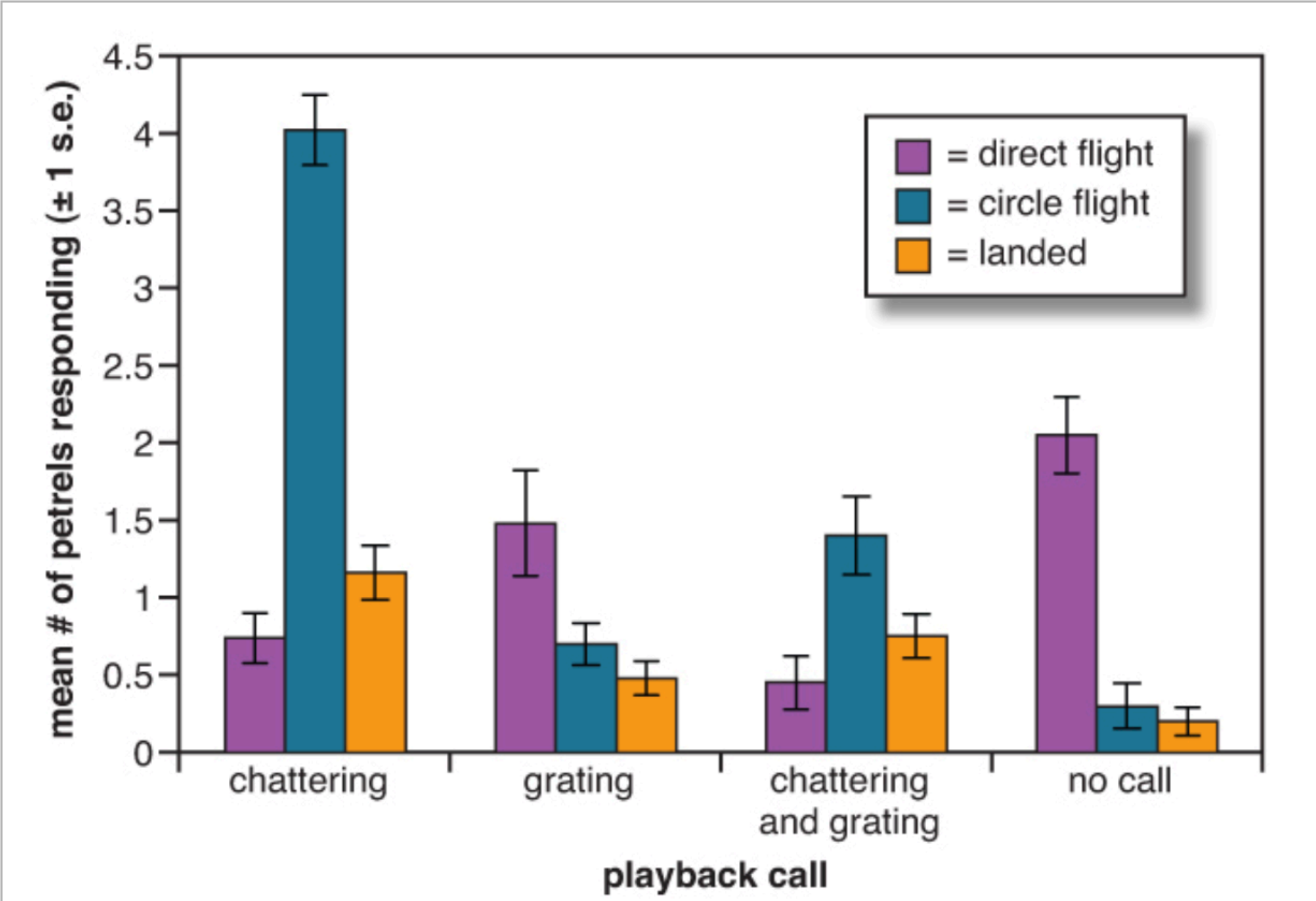
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What major differences in frequencies do you observe, are they significant?

**Random call**



# Trifecta?



**Figure 17.7** Mean number of Wilson's storm petrels responding to different acoustic signals during a playback experiment. Error bars represent the standard error (SE) of the mean. Data from Bretagnolle, 1989, Table 1.

playback call	male response				female response	
	chattering	chattering and grating	grating	no call	grating	no call
chattering	0	0	15	8	6	10
male grating	0	0	12	7	4	16
female grating	0	0	0	16	4	14

**Table 17.3** Frequency of responses by males and females to different calls during a playback experiment. Modified from Bretagnolle, 1989, Table 3. Reprinted with permission from Koninklijke Brill NV.

**Random call**

# Wilson's storm petrels responding to signals during a playback experiment

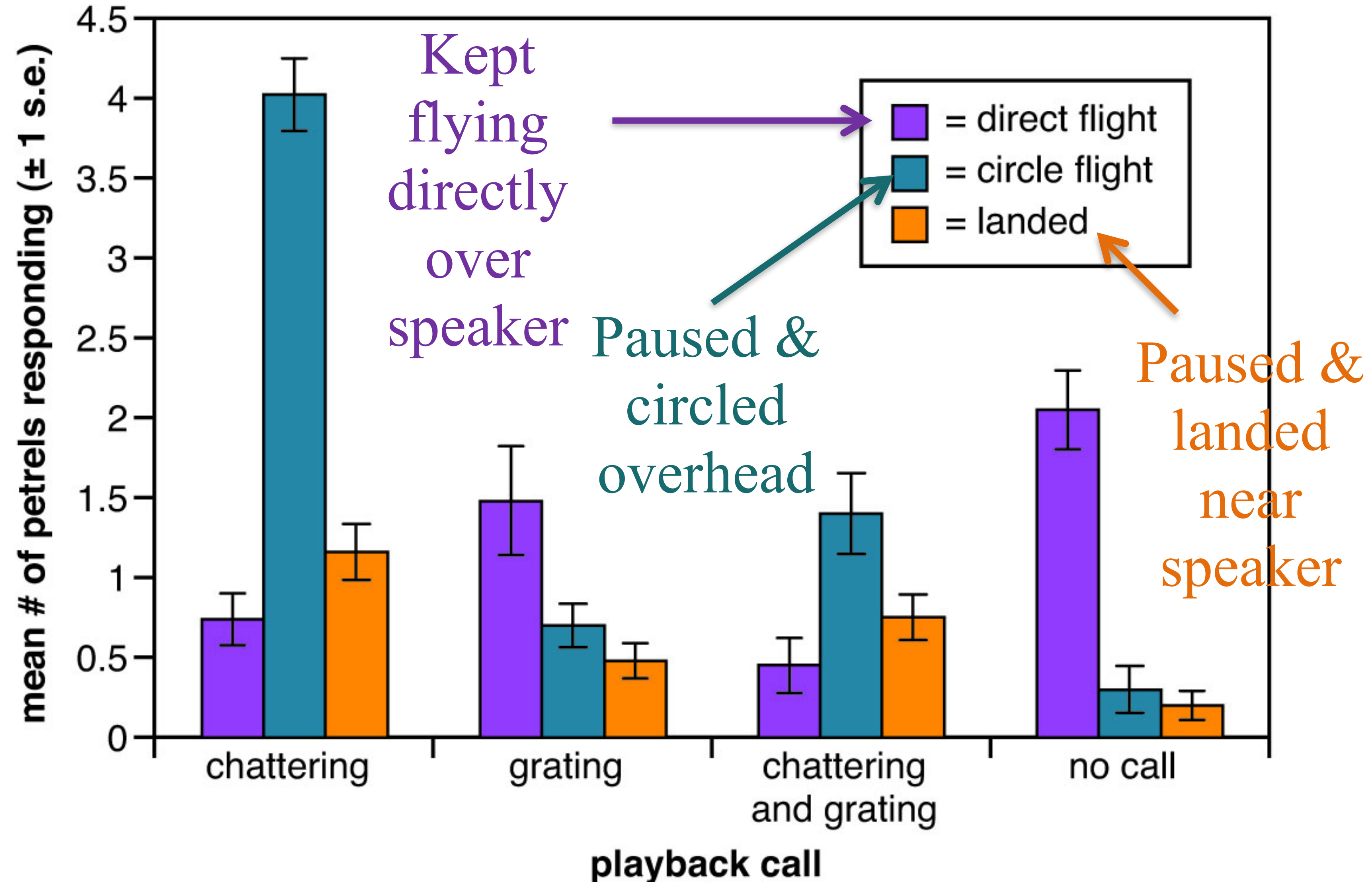


Figure 17.7

Data from Bretagnolle, 1989, Table 1



# Wilson's storm petrels responding to signals during a playback experiment

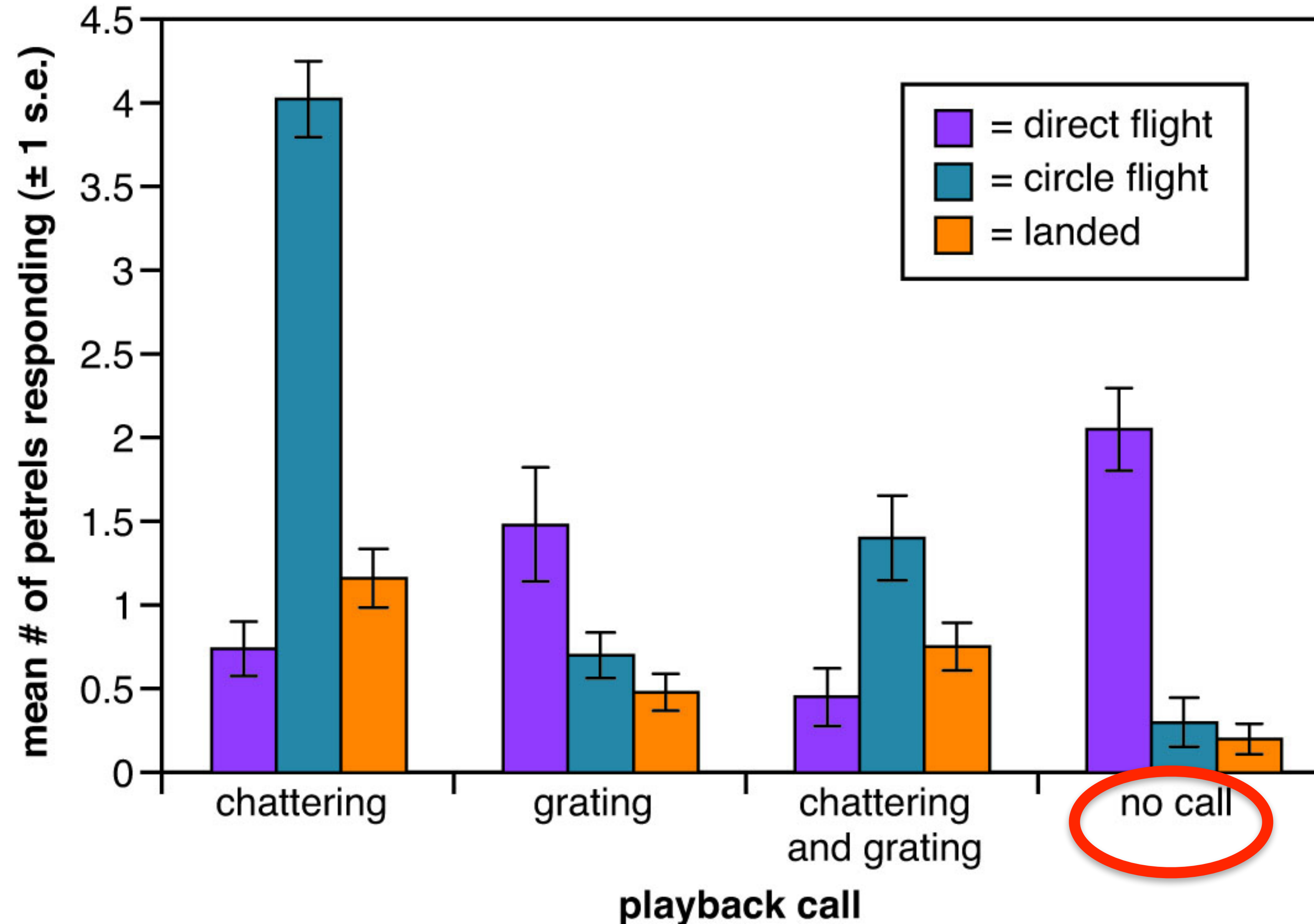


Figure 17.7

Data from Bretagnolle, 1989, Table 1



Explain: 1) How can we decode the Wilson's storm petrel language? 2) What is this figure depicting? Where is the control? How do petrels respond to different call? Is this pure observation or playback?

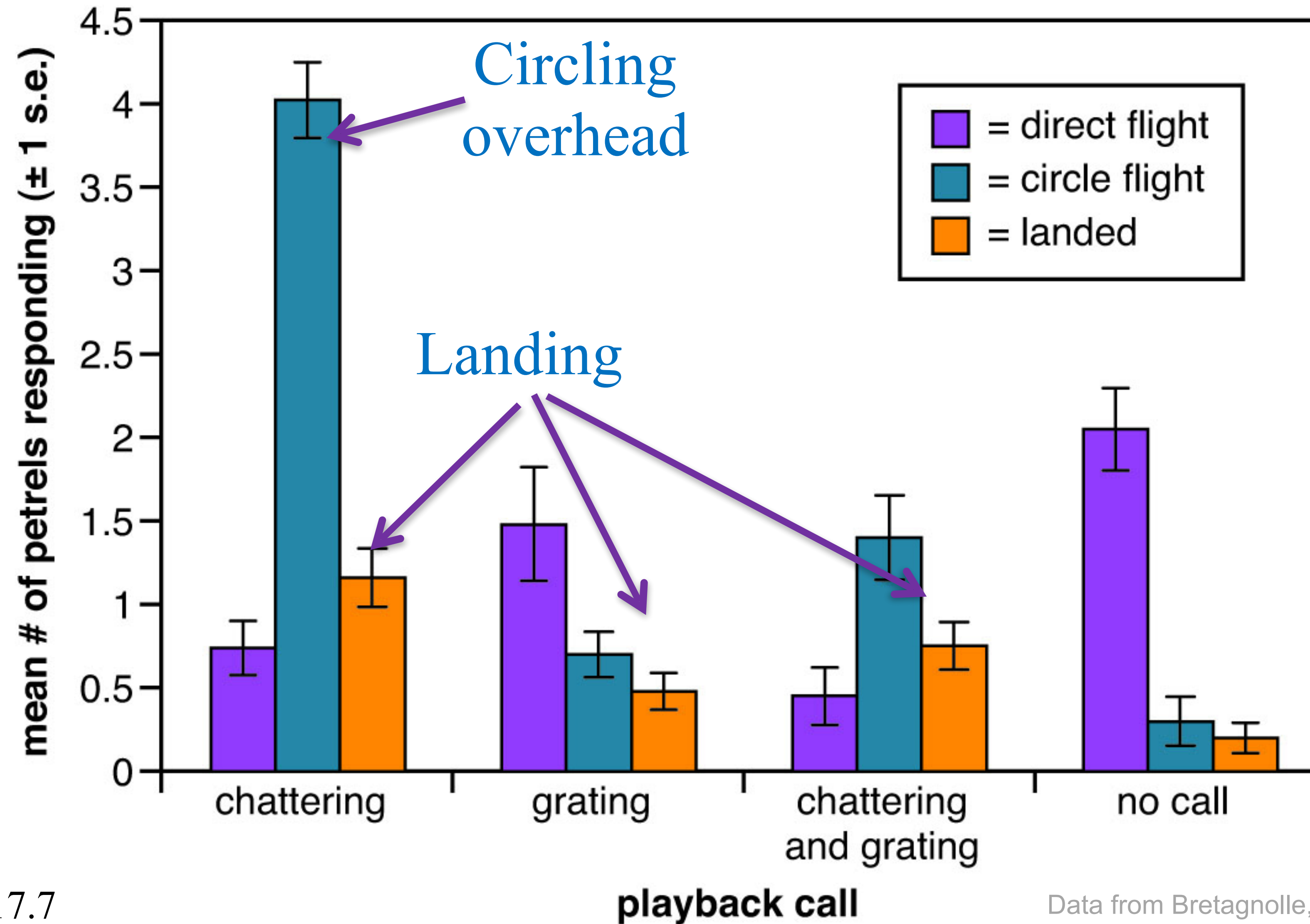


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Data from Bretagnolle, 1989, Table 1



# Trifecta?

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**Table 17.3** Frequency of responses by males and females to different calls during a playback experiment. Modified from Bretagnolle, 1989, Table 3. Reprinted with permission from Koninklijke Brill NV.

**Random call**



# What does this table even say?

TABLE 3. Frequency of responses by breeding birds to playback of different calls

Call played back	Male response			Female response			$\chi^2$ Test
	Chattering	Chattering and grating	Grating	No call	Grating	No call	
Chattering (n = 39)	0	0	15	8	6	10	2.91 NS
Male grating (n = 39)	0	0	12	7	4	16	5.8 P < 0.01
Female grating (n = 34)	0	0	0	16	4	14	2.17 NS

Differences between male and female responses are tested by  $\chi^2$  test.



# Frequency of responses by males and females to different calls during playback experiment

playback call	male response				female response	
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chattering	0	0	15	8	6	10
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Table 17.3

Modified from Bretagnolle, 1989, Table 3. Reprinted with permission from Koninklijke Brill NV



Explain: 1) How do male and female responses differ? Who chatters (and responds)? Who grates (and responds)? 2) What are the likely purposes of these calls? 3) What are the take home messages from the petrel research?

playback call	male response				female response	
	chattering	chattering and grating	grating	no call	grating	no call
chattering	0	0	15	8	6	10
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female grating	0	0	0	16	4	14

Variation among male and female storm petrels responses



Q1: Are the male Wilson's storm petrel calls situation-specific?  
How do you know?

Q2: What functions do these different calls likely serve?

playback call	male response			
	chattering	chattering and grating	grating	no call
chattering	0	0	15	8
male grating	0	0	12	7
female grating	0	0	0	16

Q3: How would you check if result is statistically significant?

How do male storm petrels respond to playback calls?



How does grading work?



# What is a 4.0?

In the university grading system

*Quantity*

PERCENTAGE of mastery = PERCENTAGE grade



# What is a 4.0?

In the university grading system

*Quality*

Quality of work = Level of grade



# What is a 4.0?

In the university grading system

**If a student does what was asked of them on an assignment and does a pretty good job what's the grade supposed to be?**

- a. 4.0
- b. 3.5
- c. 3.0
- d. 2.5
- e. other



# What is a 4.0?

In the university grading system

- The “**4.0**” is **Outstanding** is the student blew you away with how much and how well they did the work. They taught you something you didn’t know.
- A “**3.5**” is **Most Excellent** every detail of their work was done extremely well and they found additional papers and evidence beyond what they were told/expected to do, to complete their work.
- A “**3.0**” is **Excellent** is impressive work, top of the class, and their work was done extremely well but nothing beyond what was expected.
- 2.0-2.5 "Pretty Good" the student did the work required and a pretty good job, the average in the class.



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**Introduction**

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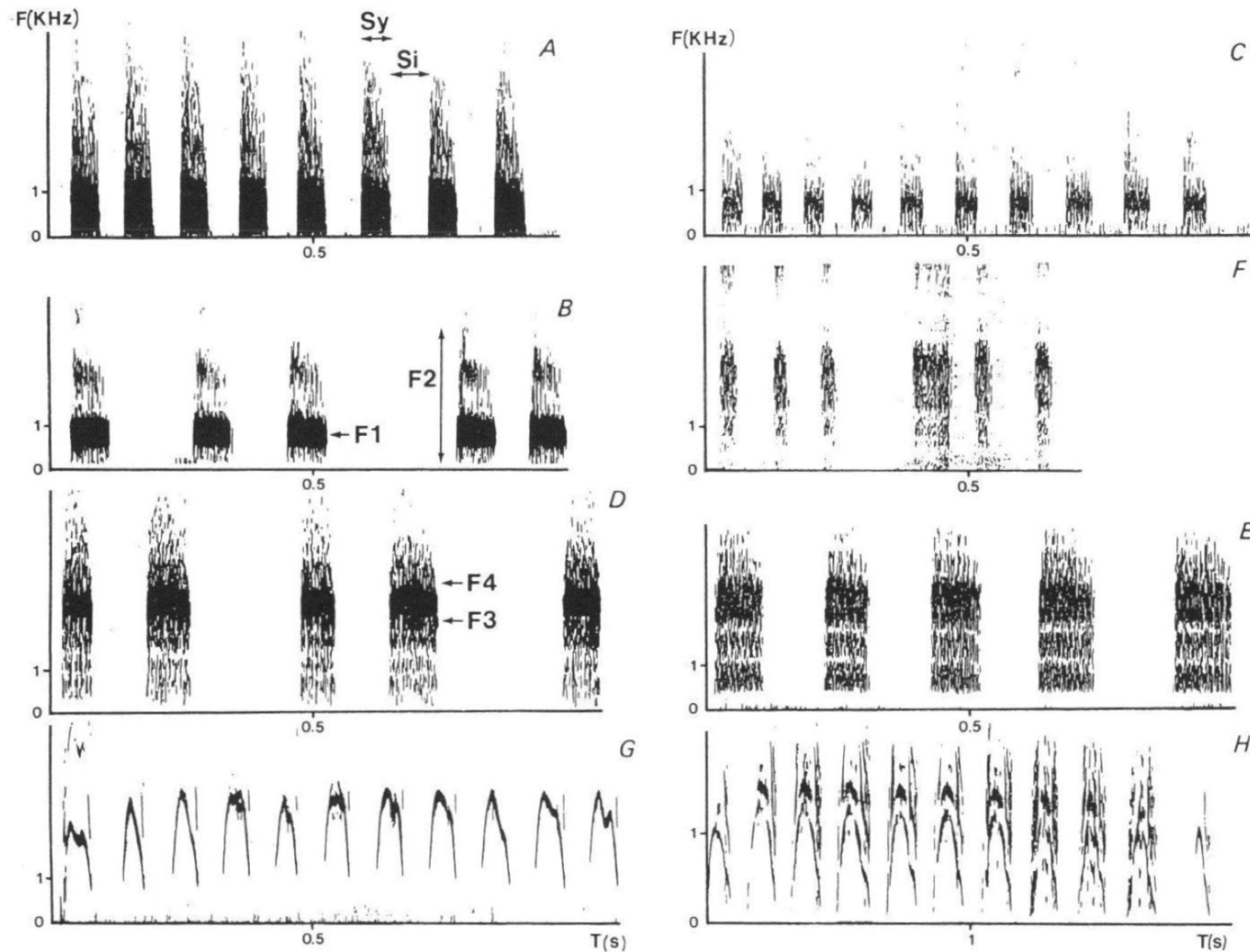


Fig. 1. Sonograms of Wilson's storm petrel vocalizations. Frequency in kHz and time in seconds. Sy and Si denote duration of syllable and silence respectively. F1 to F4 show frequencies used for analyses. A, B and C: chattering calls (A and B from Kerguelen, types B and A respectively (see text); C from Adélie Land). D, E and F: grating calls (D and E: male grating calls from Kerguelen and Adélie Land respectively; F: female grating call). G: chick call. H: peeping call of adult.



TABLE 1. Numbers of Wilson's storm petrels responding to the playback of different calls

Played back call	Behavioural responses			
	Direct flight	Circle flight	Landed	Total
Chattering call n = 43	<b>0.74</b> (0-4) 1.07	<b>4.02</b> (1-6) 1.47	<b>1.16</b> (0-4) 1.15	<b>5.92</b> 2.69
Grating call n = 43	<b>1.48</b> (0-10) 2.23	<b>0.7</b> (0-3) 0.88	<b>0.48</b> (0-3) 0.73	<b>2.66</b> 3.88
Chattering and grating calls n = 20	<b>0.45</b> (0-2) 0.76	<b>1.4</b> (0-3) 1.14	<b>0.75</b> (0-2) 0.63	<b>2.6</b> 2.53
No call played back n = 20	<b>2.05</b> (1-4) 1.1	<b>0.3</b> (0-2) 0.66	<b>0.2</b> (0-1) 0.41	<b>2.55</b> 2.17

Mean values in bold, range in brackets and standard deviations below. These data were obtained in 20 days of experimentation.

grating call are played back ( $t = 1.8$  for "circuit flight";  $t = 0.2$  for "landing").

The direct flight response (first column of Table 1) shows no significant difference for the three types of calls played back. However, chattering call and chattering and grating calls both show significant differences



TABLE 2. Status of mist-netted birds when a chattering call is played back or not

	Breeding females	Mist netted birds Males and non-breeding birds	Totals
No call played back	38 (47.5%)	42 (52.5%)	80
Chattering call played back	20 (38.5%)	32 (61.5%)	52
Totals	58	74	132

TABLE 3. Frequency of responses by breeding birds to playback of different calls

Call played back	Male response			Female response			$\chi^2$ Test
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Differences between male and female responses are tested by  $\chi^2$  test.

Both circuit flying and landing were observed in response to the playback of the chattering call. On one night, we caught and banded nine landed birds with colour plastic rings. On the following days, we examined systematically all the accessible nests in the vicinity (within a radius of 25 m around the capture point) and re-discovered five birds. All were males, occupying a burrow less than 5 m away from the capture place. Similarly, we followed six birds in circuit flight over a calling male, and these were all females.

Although the numbers of birds involved in mist netting and these two



TABLE 4. Frequencies of types of call uttered by males in three different situations

Situation of the bird	Call uttered			$\chi^2$ Test
	Chattering	Chattering and grating	Grating	
Bird alone (n = 96)	38	35	23	2.85 NS
Flown over by another bird (n = 69)	33	18	18	41.5 P < 0.001
Facing another bird (n = 95)	9	16	70	48.7 P < 0.001

A  $\chi^2$  test compares the results between first and second, second and third, and first and third situation, respectively.

ferently to male and female grating calls, thus indicating an ability to identify the sex of the calling bird ( $\chi^2 = 12.7$ ;  $P < 0.001$ ). Males and females also responded differently to male grating calls ( $\chi^2 = 5.8$ ;  $P < 0.01$ ).

Table 4 compares the types of calls given by males (from outside the burrow) in three situations: when alone, when flown over and when facing another bird. It shows that the grating call was essentially used



TABLE 5. Frequencies of types of grating call uttered by males when involved either in Male-Male or in Male-Female interactions

Male-Male interactions (n = 45)		Male-Female interactions (n = 37)		$\chi^2$ Test
Short version	Long version	Short version	Long version	
<b>16</b> (36%)	<b>29</b> (64%)	<b>33</b> (89%)	<b>4</b> (11%)	3.56 P < 0.05

TABLE 6. Comparison between male and female grating calls

Physical characters	Male grating call	Female grating call	
Mean F3 n = 38	3.4	3.8	P < 0.01
Mean F4 n = 20	4.6	5.2	P < 0.001
First syllable duration	112.8 (n = 23)	77.2 (n = 10)	P < 0.02
First silence duration	201.8	197.2	NS
Second syllable	108.8	69.8	P < 0.03
Second silence	228.8	258.5	NS
Third syllable	154.4	160.9	NS
Third silence	177.6	121.8	P < 0.02
Fourth syllable	146.9	76.26	P < 0.03
Fourth silence	240.9	262.3	NS

Frequency is given in KiloHertz and temporal parameters are given in milliseconds. See Fig. 1 for F3 and F4 representations. T-test has been used for statistical analysis.



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