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Studying primate emotions out of the lab: Adding an **infrared thermographic** camera in the basic fieldwork kit of primatologists?

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1. INTRODUCTION

- Infrared thermography (IRT) is pioneered as a fully non-invasive, contact-free technique to examine changes in emotional states
- IRT has been used successfully to measure emotion-related changes of surface skin temperature in many domestic species and captive non-human primates
- IRT has been well-tested in lab and captivity
- It is time to go out of the lab to address new questions in more ecologically-relevant contexts**
- However, in the wild, many environmental factors and constraints linked to a highly specific equipment can affect the accuracy of the IRT measurements
- This study aims at highlighting these factors and giving some solutions to control their potential impacts on IRT measurements

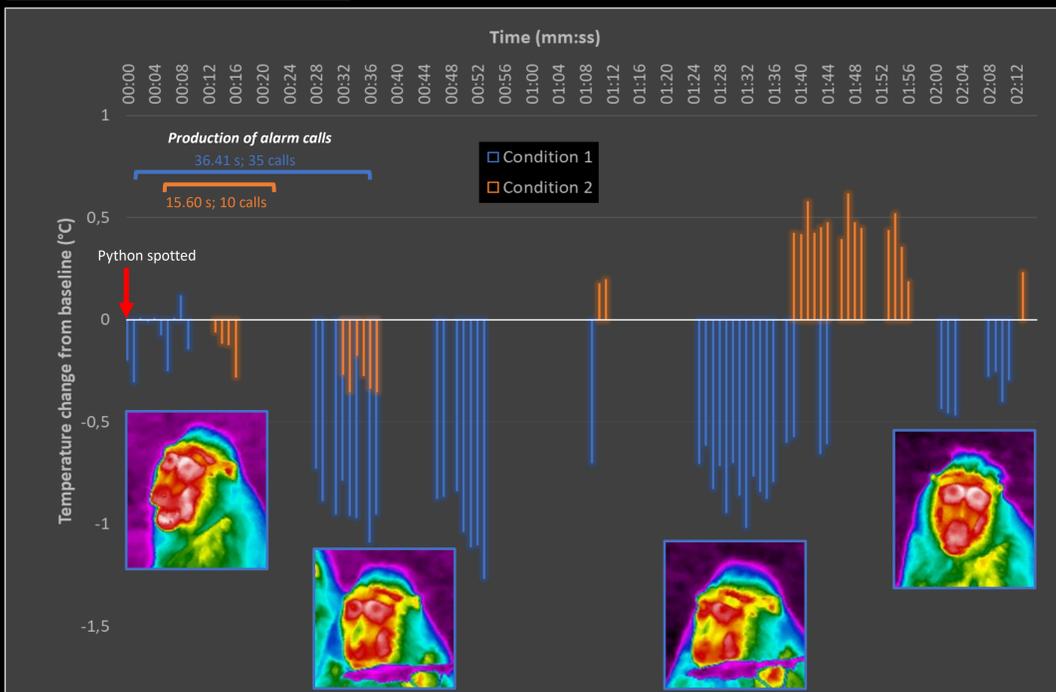
2. CHOOSING THE INFRARED THERMOGRAPHIC CAMERA

- Trade-off between the needs of the study and the budget;
- Many options on the market;
- 2 examples at both sides of the price spectrum:

	ThermAPP-TH	FLIR T5XX-T6XX
PROS	<ul style="list-style-type: none"> Relatively cheap (~2 000 €) Small & light to carry Lower image quality but satisfying enough at short distance (< 3 m) 	<ul style="list-style-type: none"> Higher image quality & sensitivity IRT pictures & videos (30 Hz) Auto focus / laser meter Professional Analysis software and flexible
CONS	<ul style="list-style-type: none"> Lower sensitivity IRT pictures only (no IRT videos) Focus manually Analysis Software quite basic and not flexible 	<ul style="list-style-type: none"> Very expensive (~20 000 €) Quite heavy to carry

4. FEW EXAMPLES OF POTENTIAL APPLICATIONS...

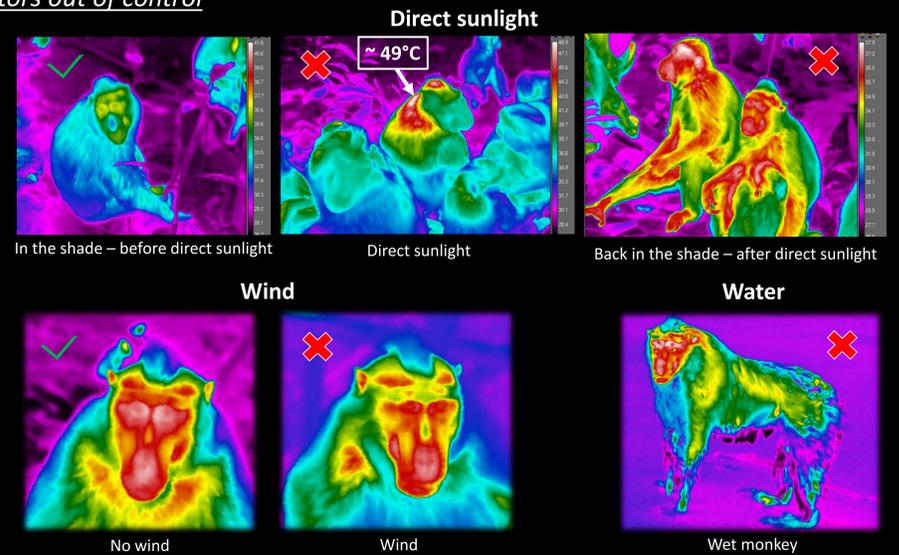
Emotions and Communication



Temperature change of the nasal region and the alarm call production after the focal animal has spotted a fake python.
Condition 1: the focal animal heard the playback of contact calls of an affiliate groupmate before seeing the model python.
Condition 2: the focal animal heard the playback of contact calls of a non-affiliate groupmate before seeing the model python. The baseline was recorded 30 s before the beginning of the experiment. Data extracted from IRT videos recorded with an IRT camera FLIR T560 on N = 1 adult female crested macaque.

3. VARYING ENVIRONMENTAL FACTORS...

Factors out of control



Factors partially controllable

Angle

On the ground

2-3 m above the ground

More than 3 m above the ground
-> no recording

Distance to focal animal

1. Taking many pictures of monkeys at different distances

2. Measuring the number of pixels

Nbr. of pixels = 26767
=> Distance = 2.1 m

Air temperature & humidity (connected to distance to the target)

1. Using a Temperature/humidity logger = known relative air temperature/humidity at any time

2. Taking pictures of a reference at different distances = control for these factors on IRT measurements

Reference:

- known emissivity ($\epsilon = 1$)
- Hanging at monkey's height
- Camera at 1, 2 & 3 m from the reference (using a laser meter)
- Taken after each IRT recording

Number of pixels

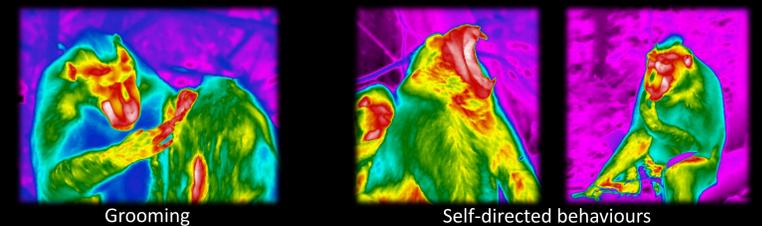
Distance to focal animal (m)

27.7 °C @ 1 m

27.8 °C @ 2 m

26.9 °C @ 3 m

Emotions and (social) Behaviours



Thermography and Reproduction



IRT images and corresponding pictures in the visible range of the same individual (an adult female) taken at two different times of her swelling cycle

5. CONCLUSION

- IRT is **reliable** and **accurate** to study emotions in wild non-human primates in tropical forest
- Some environmental factors are not controllable = this technique is not suited to arboreal species and species living in open areas
- But other factors are partially controllable if rigorously assessed during data collection
- Thanks to this technique, new questions in more ecologically-relevant contexts can be addressed**