

Startle reflex physiology in odontocetes

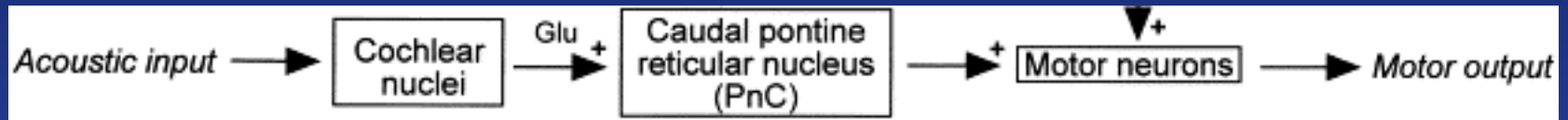
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University of St Andrews, Scotland/UK

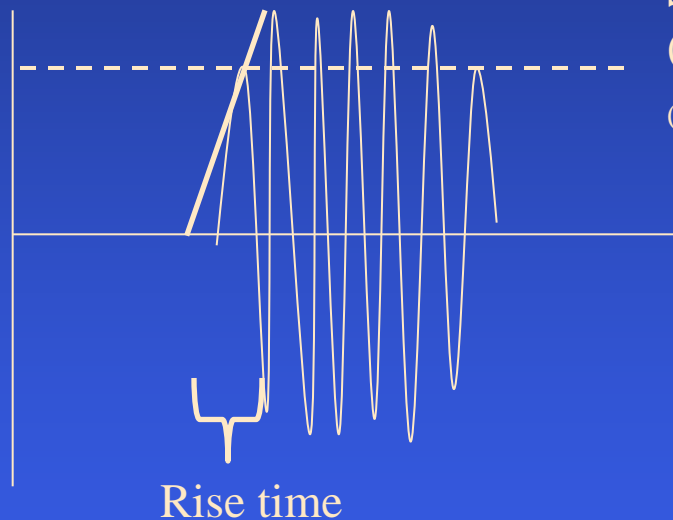
²Hawai'i Institute of Marine Biology, University of Hawai'i at Manoa

Startle reflex: Rise-time



Koch & Schnitzler (1997): Behavioural Brain Research

Amplitude



Startle threshold

(80-90 dB above hearing threshold)

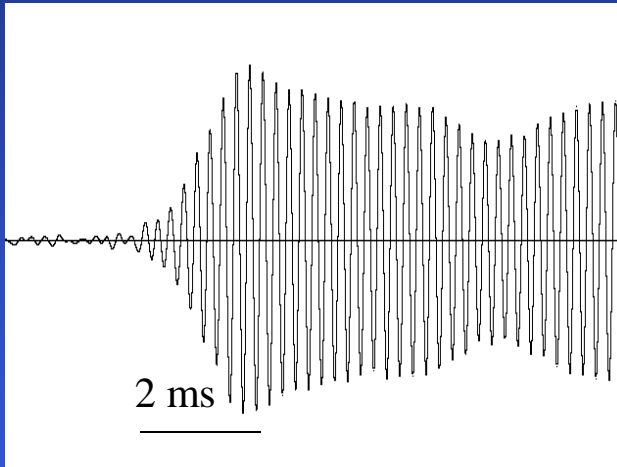
(Pilz & Schnitzler, 1987 *J. Comp. Psychol.* 101:67-72)

→ Reflex elicited if sound exceeds startle threshold within 15-20m of its onset

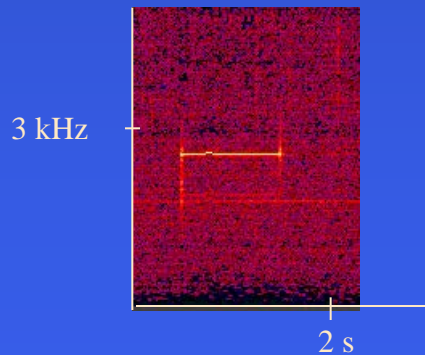
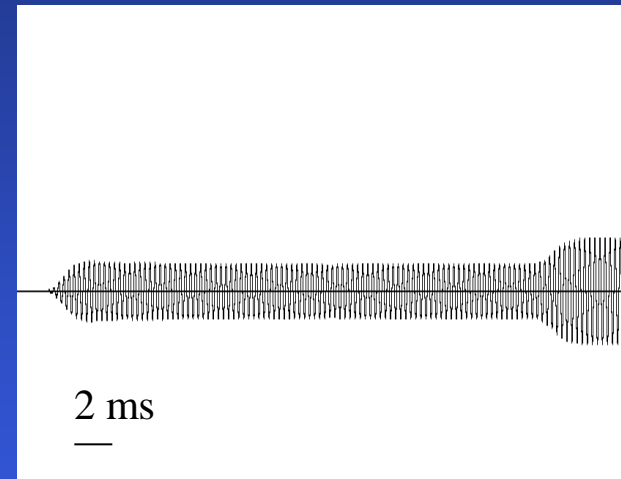
Fleshler (1965) *J.Comp.Physiol. Psychol.* 60:200-207.

Can MFA sonar elicit startle responses?

Sonar signal recorded during Halo Strait incident

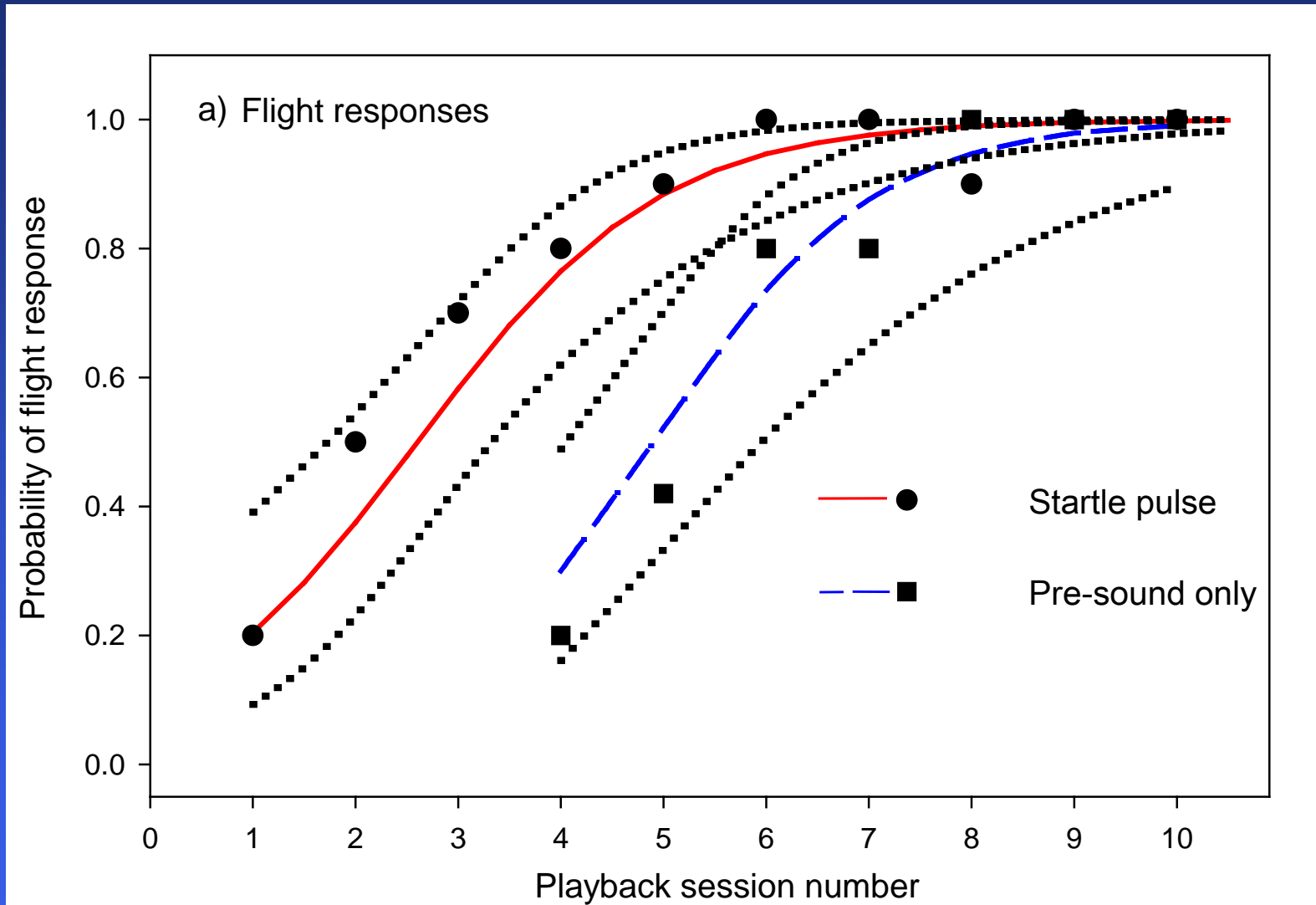


BRS-MFA (Dtag recording)





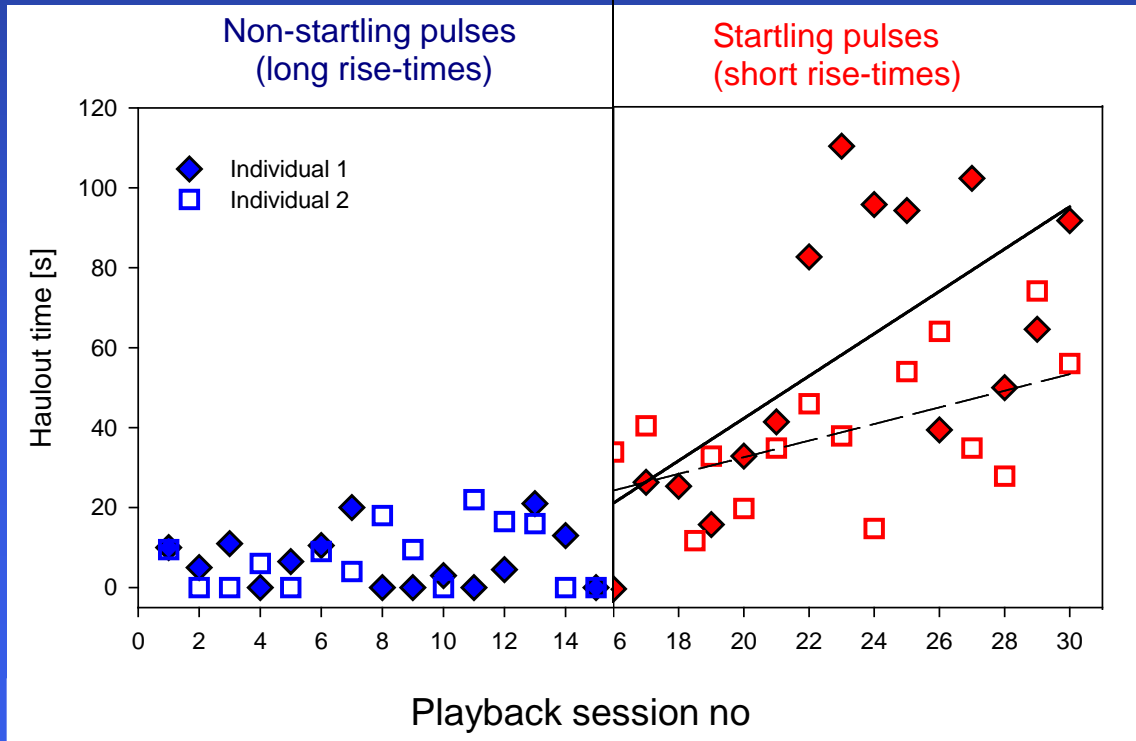
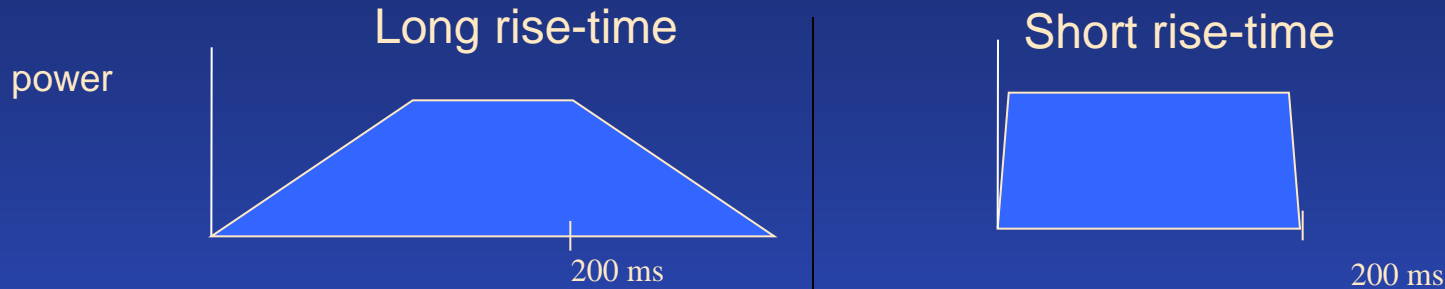
Flight responses associated with the startle reflex





Experiment 3: Effect of rise-time

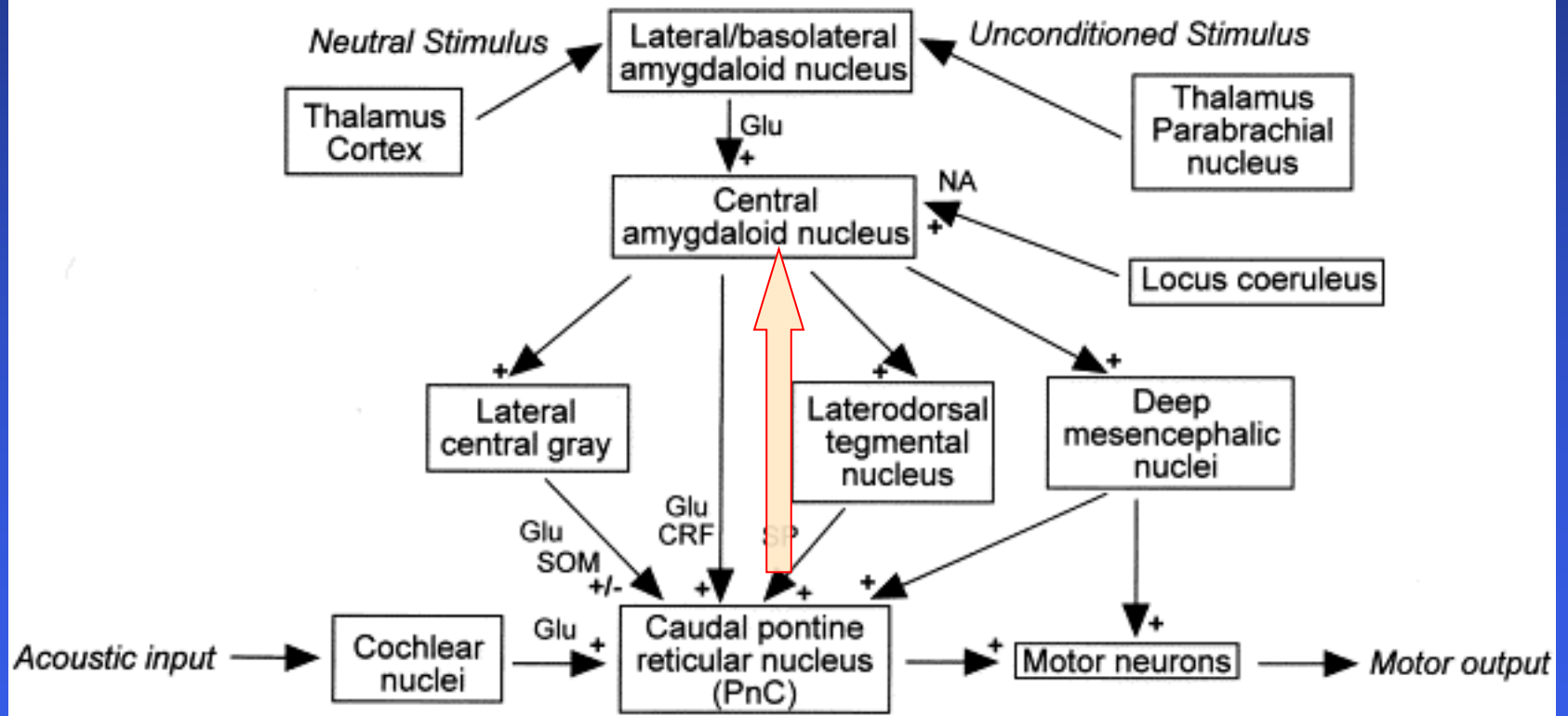
tested two stimuli with different rise-times (and length) but equal energy (SEL)





Startle pathway

A hypothetical circuit for the enhancement of startle by fear or anxiety





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Startle in odontocetes



Kina



Boris

BJ

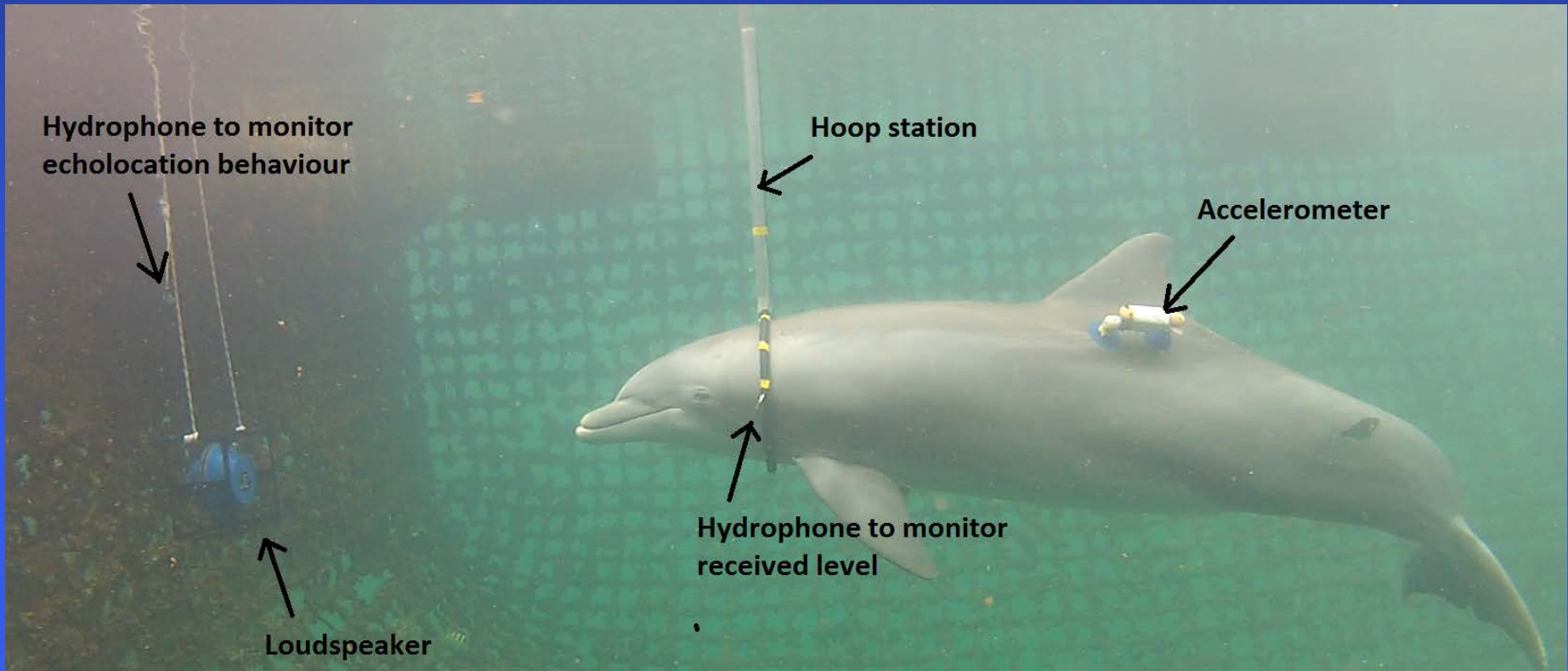


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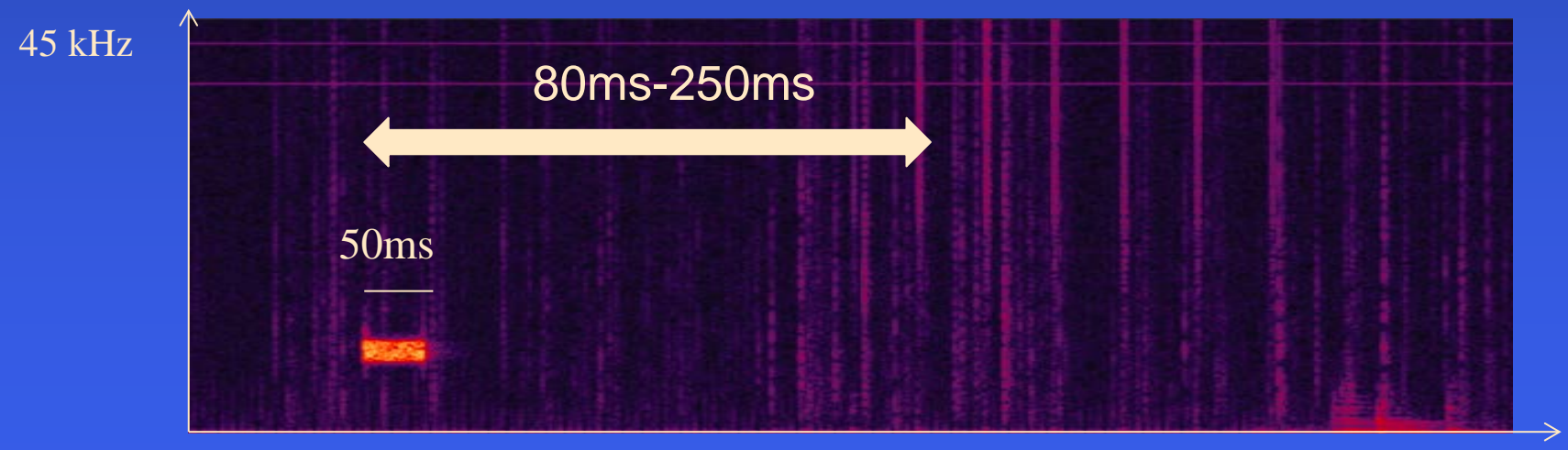
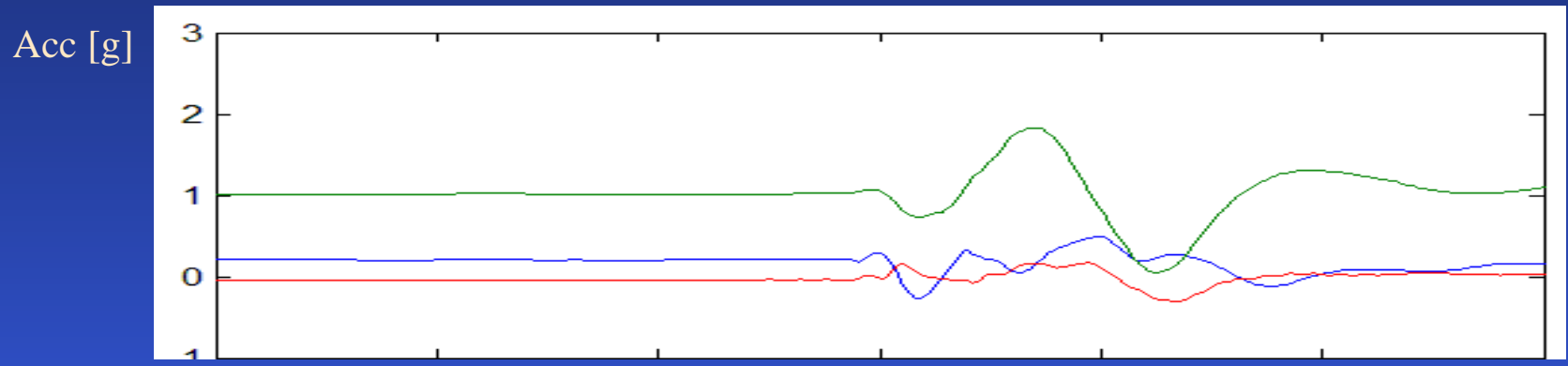
Startle in odontocetes



- 1/3 octave band noise pulses (50ms length)
- Synchronisation: tapping hydrophone against accelerometer
- 12 trials per session, 1 session per day
- between 1-3 sessions per frequency
- Wait times between 3s and 58s
- 6 dB steps down and up

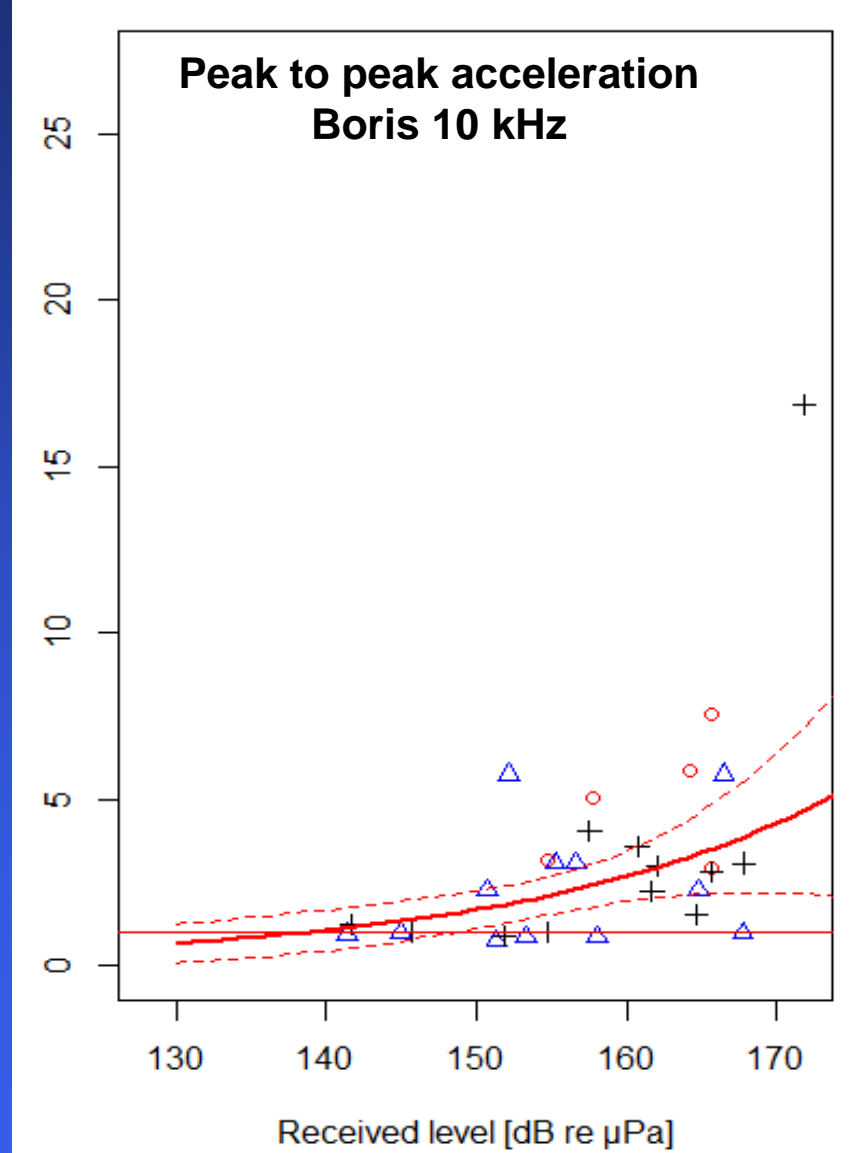
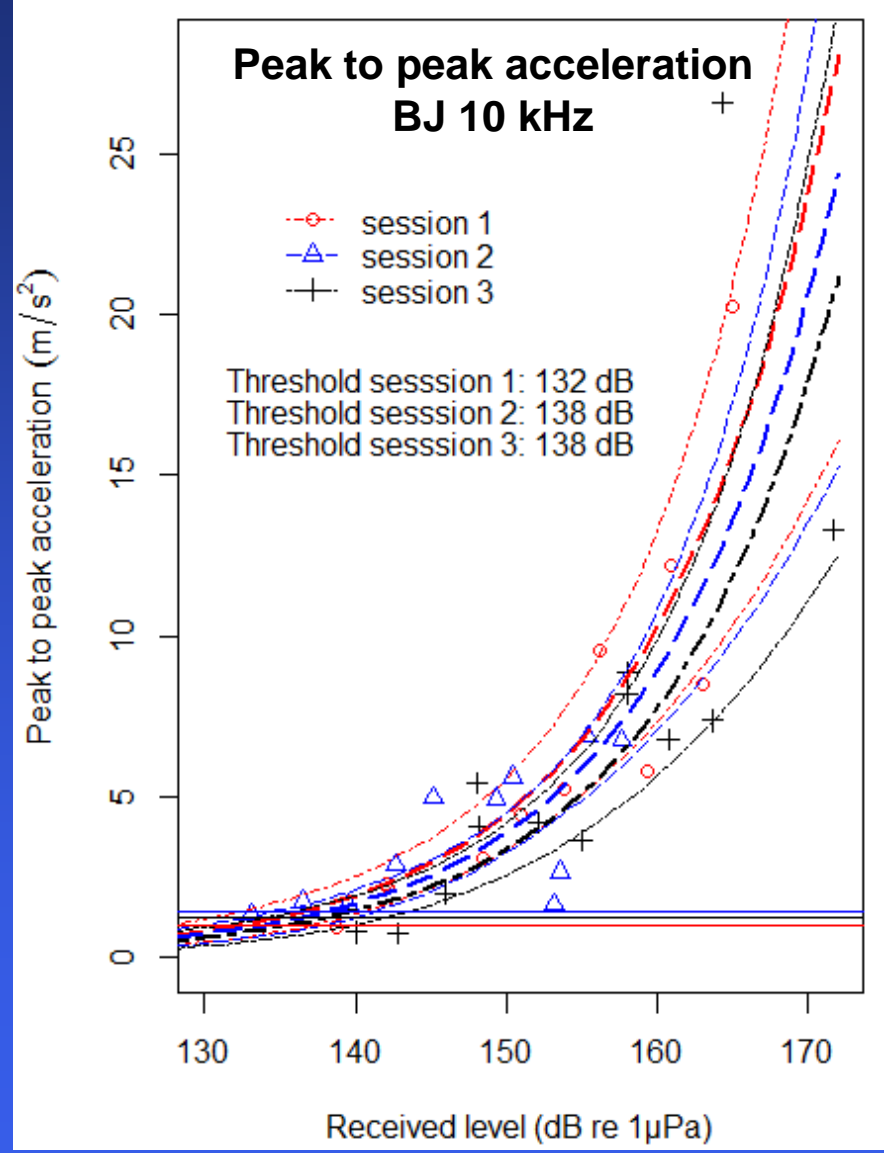


Startle in odontocetes



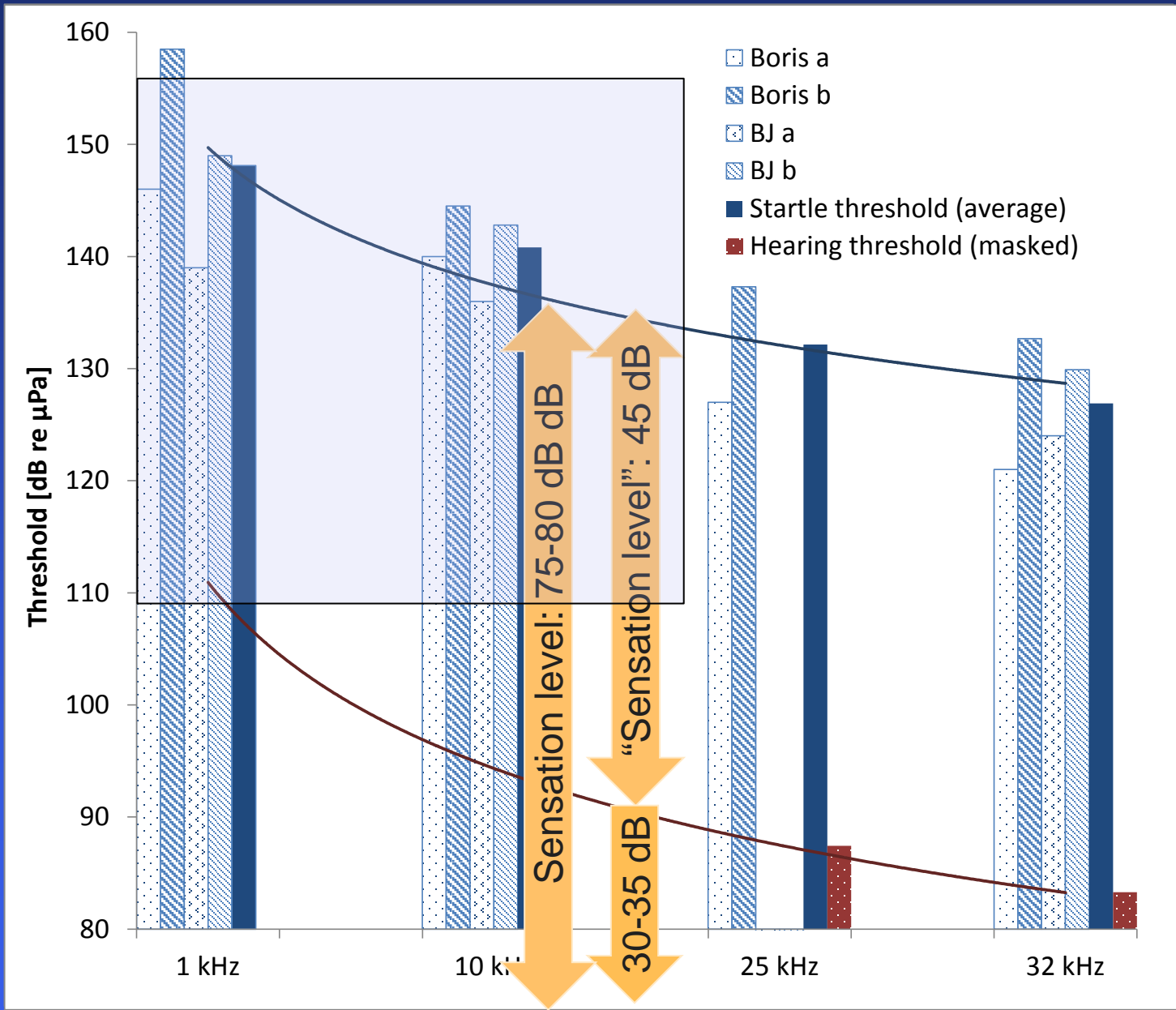


Startle thresholds





Startle and auditory thresholds





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Effect of rise-time: BJ

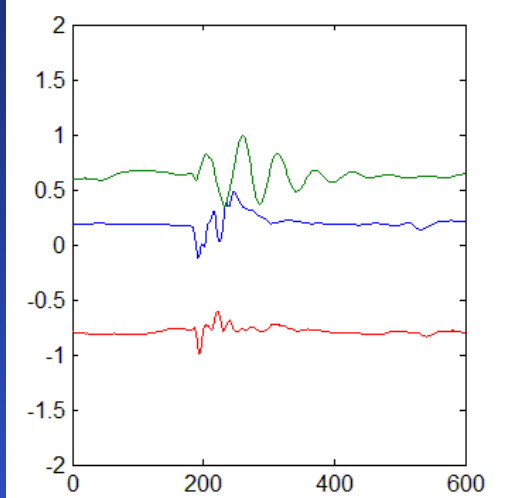
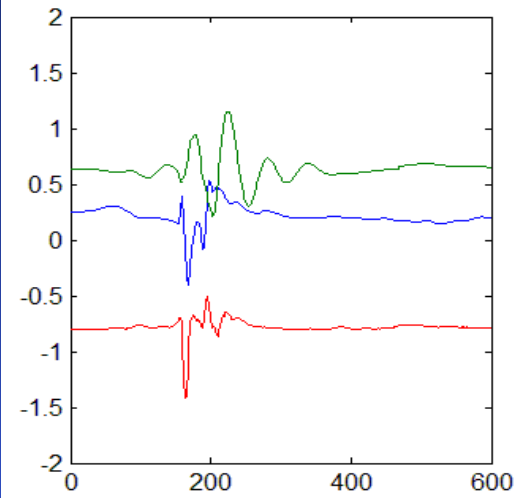
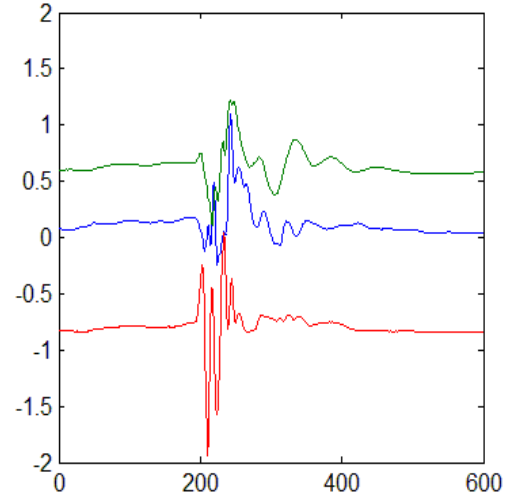


2 ms

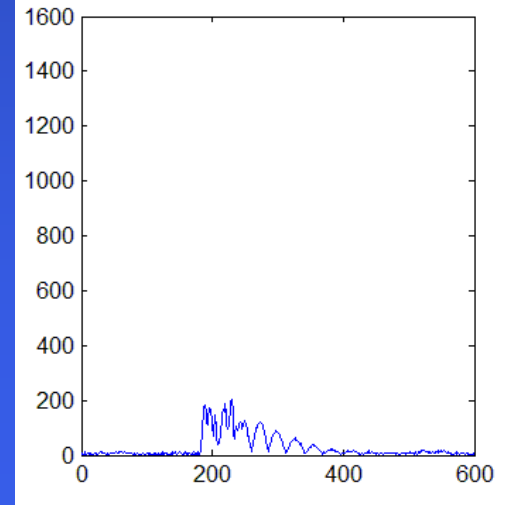
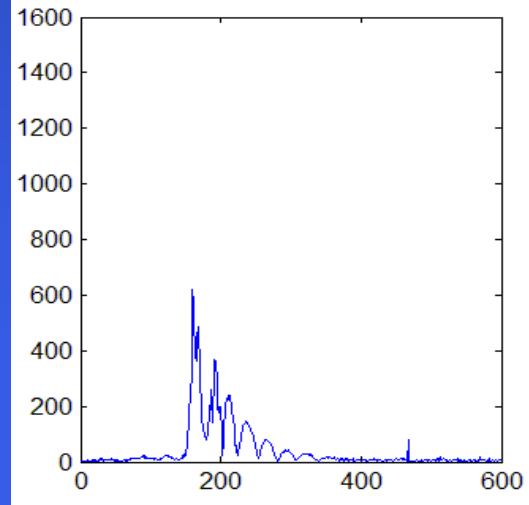
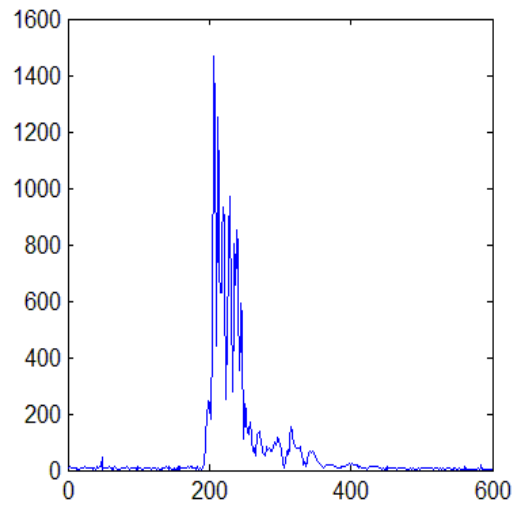
20 ms

100 ms

Acc
[g]

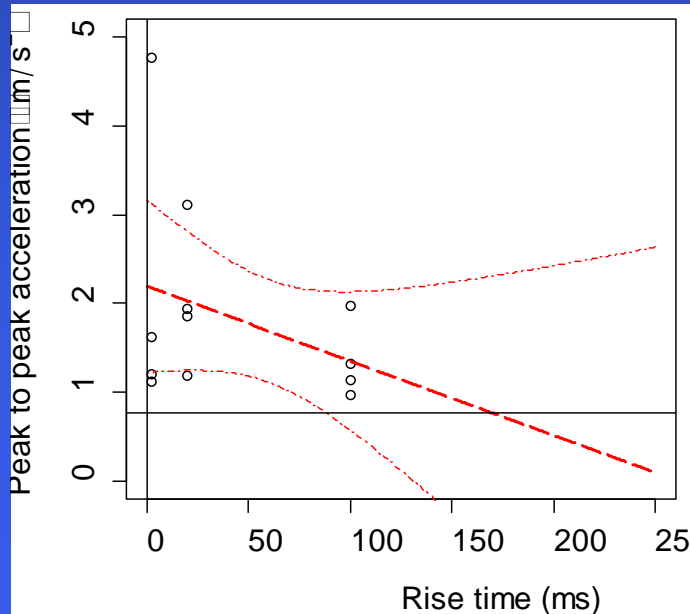
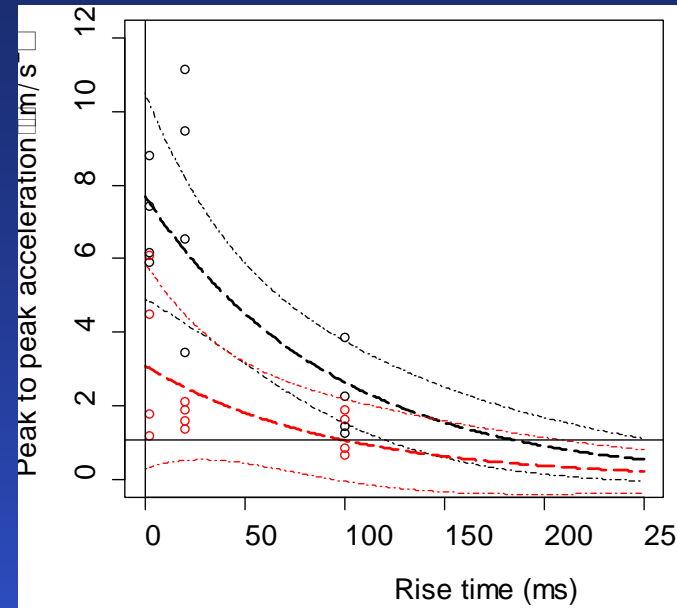
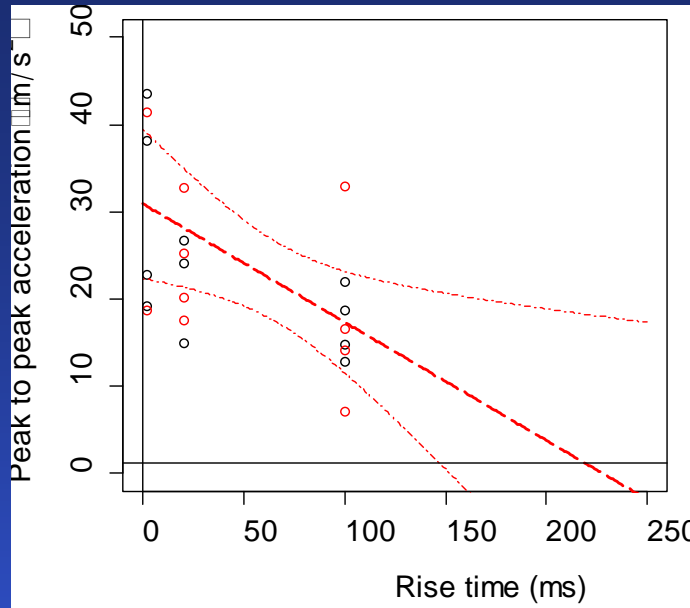


Norm
jerk
[m/s²]





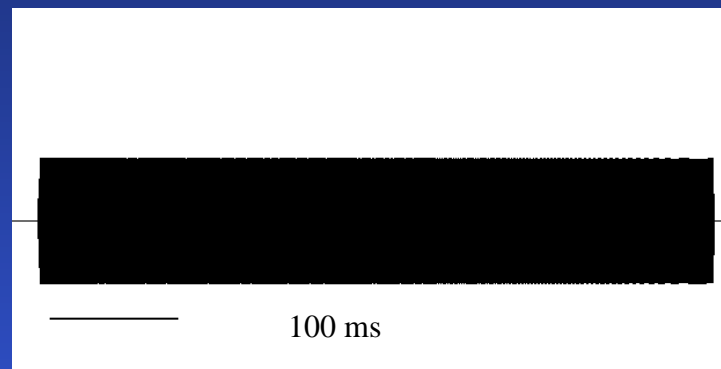
Effect of rise-time



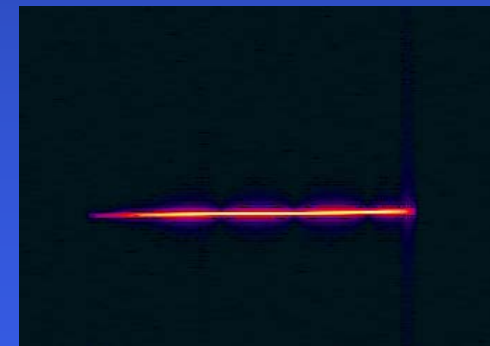
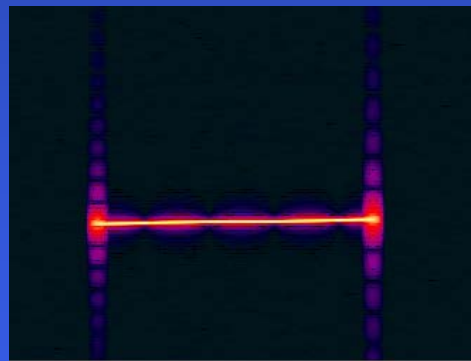
- Rise-times between 100 and 250ms are sufficient to mitigate startle responses in a broadband stimulus
- Most likely shorter rise-times will be sufficient for pure tones

Investigating rise-time as mitigation method

**BRS-MFA
(original)**



**Possible BRS-MFA-LRS
(long rise-time)**



Startle reflex in odontocetes

- **Startle can be reliably elicited in odontocetes**
 - Basic reflex is conserved in spite of adaptations to echolocation behaviour
 - Startle can probably be used for acoustic deterrence similar to pinnipeds
 - Include rise-time in noise impact criteria and model rise-time in BRS data !
- **Startle magnitude decreases with increasing rise-time**
 - Mitigation should be possible
- **PPI is present in odontocetes**

Acknowledgements

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Riaghaltas na h-Alba



Marlee Breese, Chris, Tyler