

Psychoacoustics of Rock Art Sites: the Case Study of the Shelters Diosa I and Horadada (Cádiz, Spain)

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Rock Art Soundscapes



Horseshoe Canyon, Utah, US
(John Fowler)



Rocher à l'Oiseau, Canada
(Díaz-Andreu et al., 2017)



Julma-Ölkky, Finland
(Rainio et al., 2018)



Rock Art Soundscapes

Diosa I site (Cádiz, Spain)



Horadada site (Cádiz, Spain)

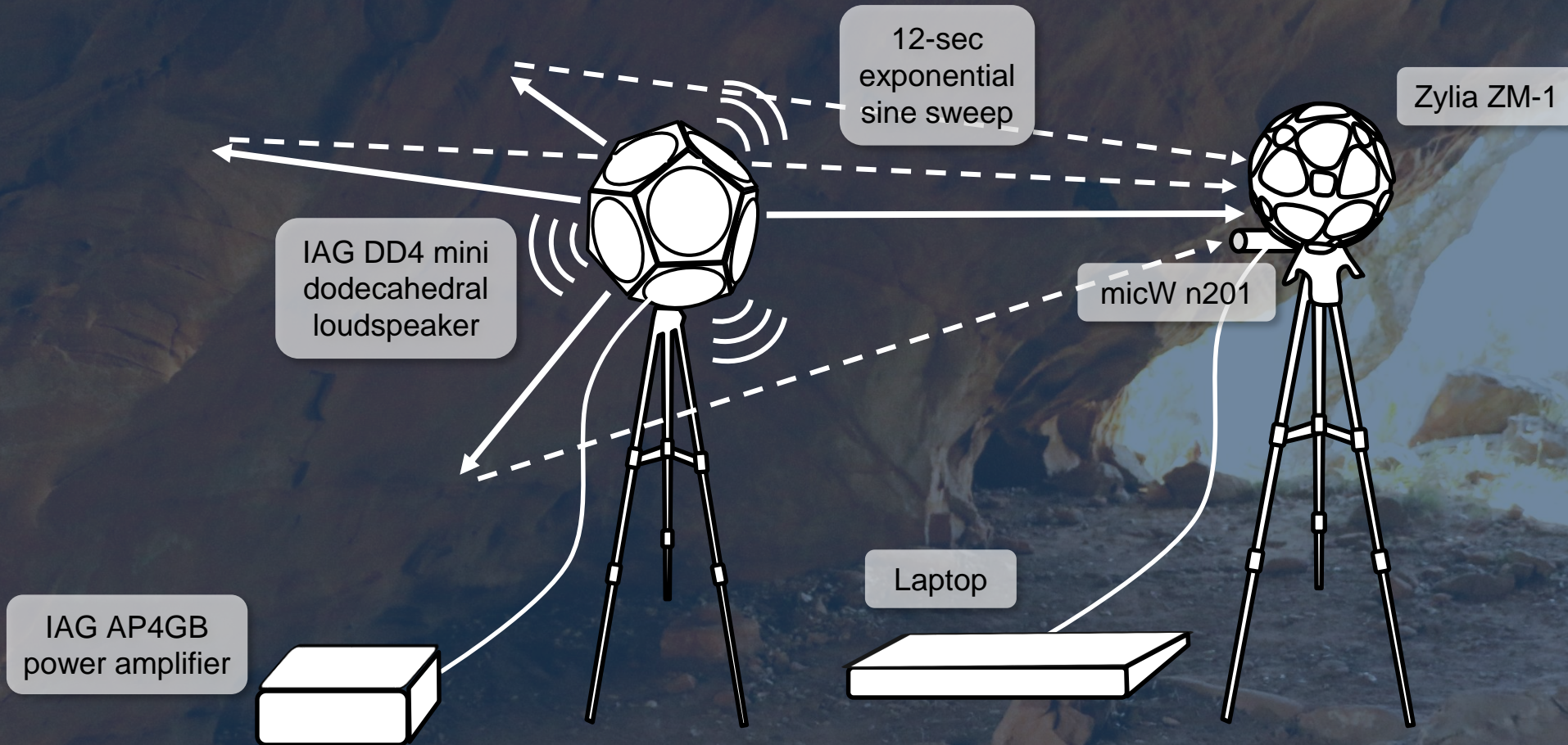


Obispo I site (Cádiz, Spain)



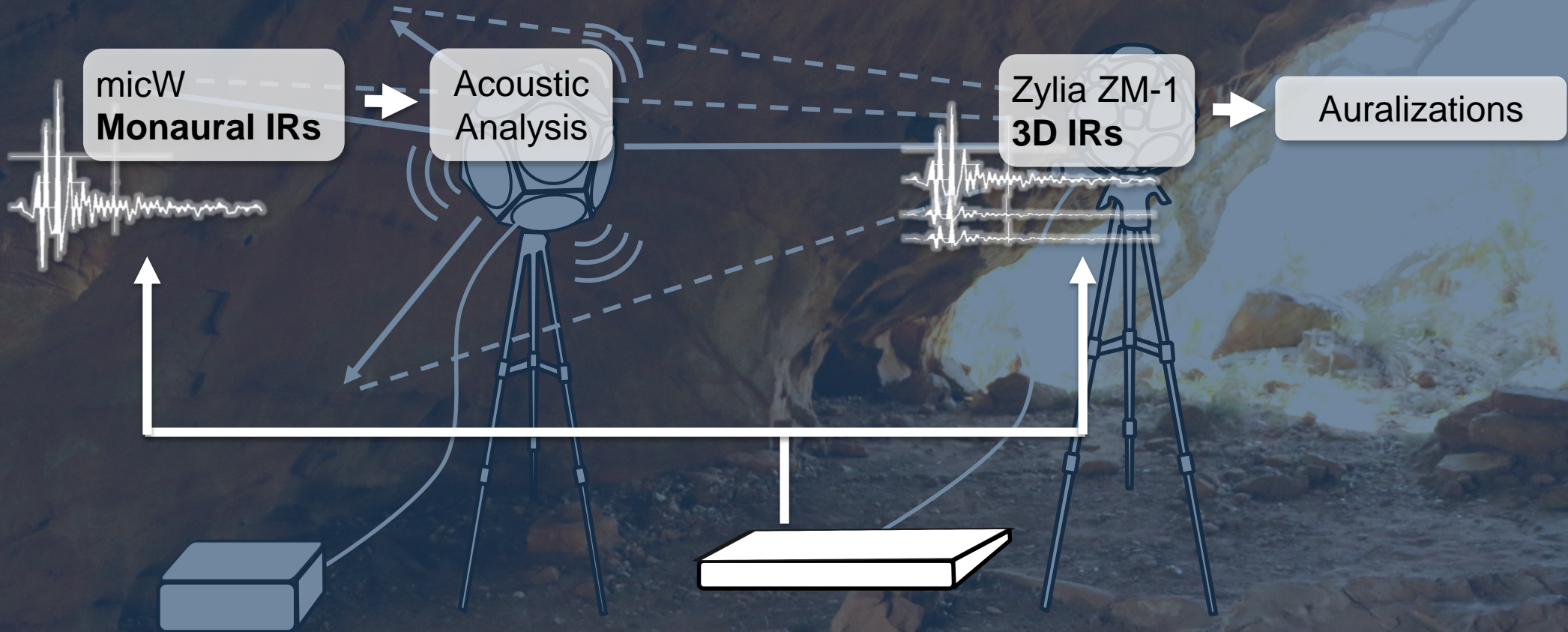


Recording method



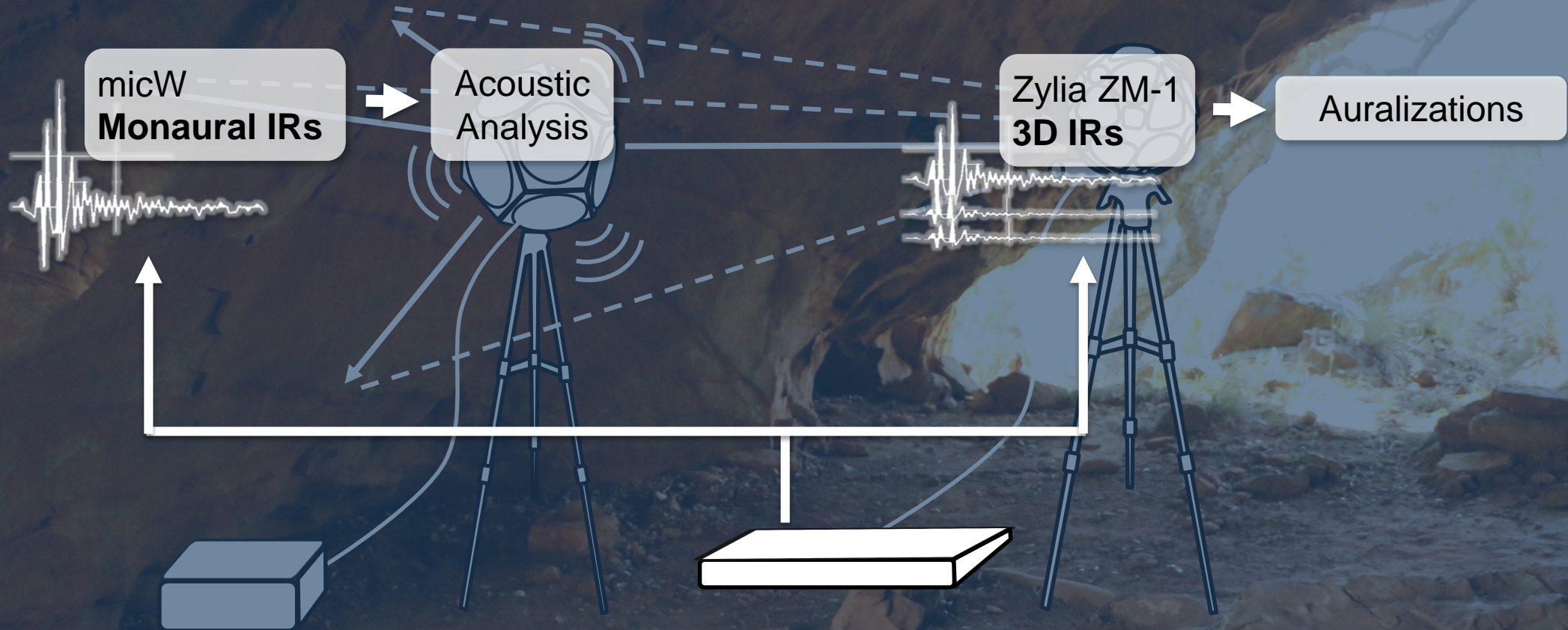


Recording method





Recording method





Listening tests





Listening tests: stimuli

- Sound 1: **Bullroarer**
- Sound 2: **Clarinet**
- Sound 3: **Conch ornament**
- Sound 4: **Dama (singing)**
- Sound 5: **Drum**
- Sound 6: **Flute**
- Sound 7: **Jaw**
- Sound 8: **Lladre (singing)**
- Sound 9: **Rattle**
- Sound 10: **Speech**



IMPULSE RESPONSES

- Sound 1: **Bullroarer**
- Sound 2: **Clarinet**
- Sound 3: **Conch ornament**
- Sound 4: **Dama (singing)**
- Sound 5: **Drum**
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HORADADA (HO)





IMPULSE RESPONSES

- Sound 1: **Bullroarer**
- Sound 2: **Clarinet**
- Sound 3: **Conch ornament**
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- Sound 6: **Flute**
- Sound 7: **Jaw**
- Sound 8: **Lladre (singing)**
- Sound 9: **Rattle**
- Sound 10: **Speech**



DIOSA I (DS1)





- Sound 1: **Bullroarer**
- Sound 2: **Clarinet**
- Sound 3: **Conch ornament**
- Sound 4: **Dama (singing)**
- Sound 5: **Drum**
- Sound 6: **Flute**
- Sound 7: **Jaw**
- Sound 8: **Lladre (singing)**
- Sound 9: **Rattle**
- Sound 10: **Speech**

IMPULSE RESPONSES

IRs IDs	T_{20m} (s)	ξ (‰)	C_{80m} (dB)	D_m	G_m (dB)	S-R dist (m)
 HO	0.26	5.99	19.05	0.93	9.95	7.50
 DS1	0.66	4.00	5.25	0.59	24.15	5.50



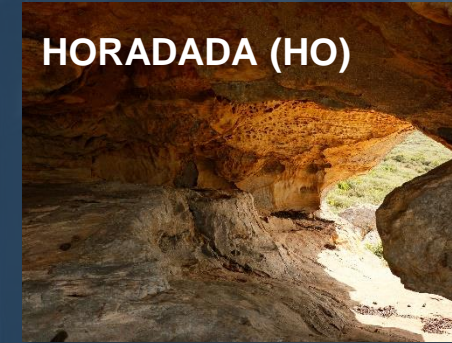
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IMPULSE RESPONSES

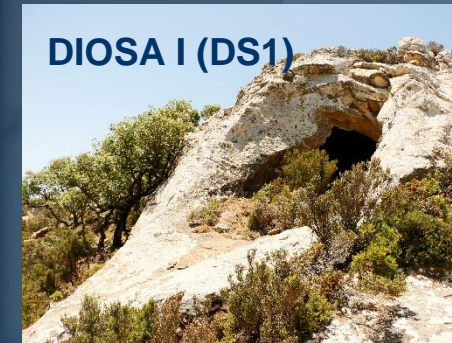
CONVOLUTION

*MatrixConv
(SPARTA plugins)

HORADADA (HO)



DIOSA I (DS1)



DECODE
for loudspeaker
config

*AIIRA Decoder
(IEM plugin suite)



Listening test 1: procedure

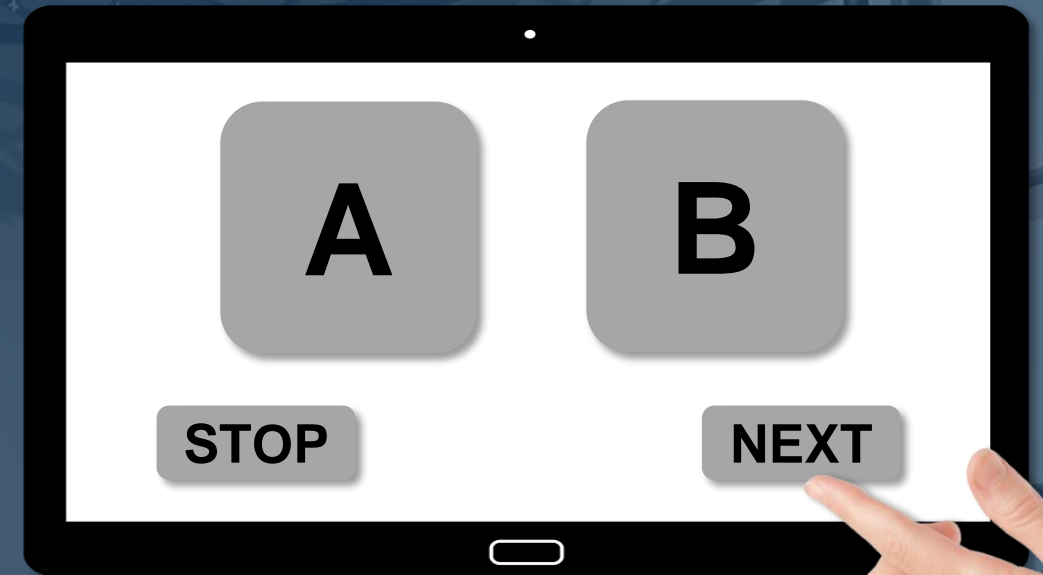
Describe the differences

Trial 1

A	B
- further - more reverb - duller -	- less reverb - less intense - -

Trial 2

A	B
- further - more reverb - duller -	- less reverb - less intense - -



- N = 10
- A / B: each sound + 2 IRs
- 10 trials
- Random order of trials
- Random order A / B within trial

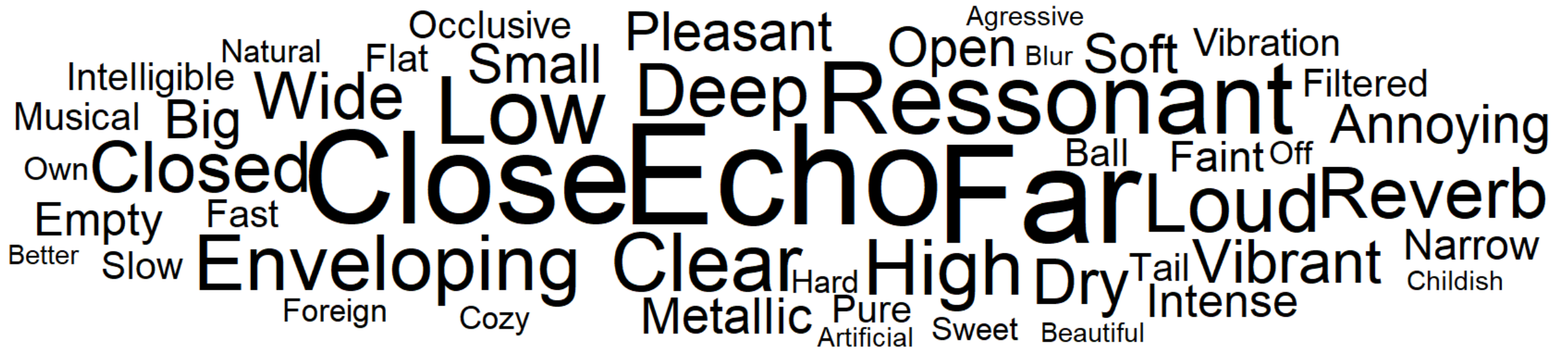


Listening test 1: results

569 words collected

Remove repetitions

91 different words





Listening test 2: procedure

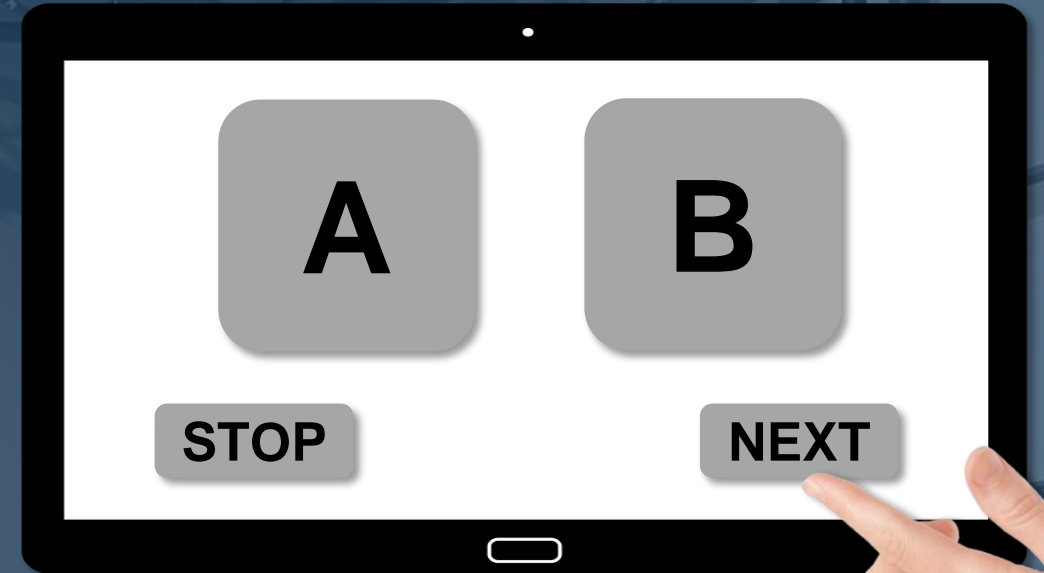
Which one...

Trial 1

	A	B
...has more echo?	x	
...is farther?		x
...is more enveloping?	x	
...		

Trial 2

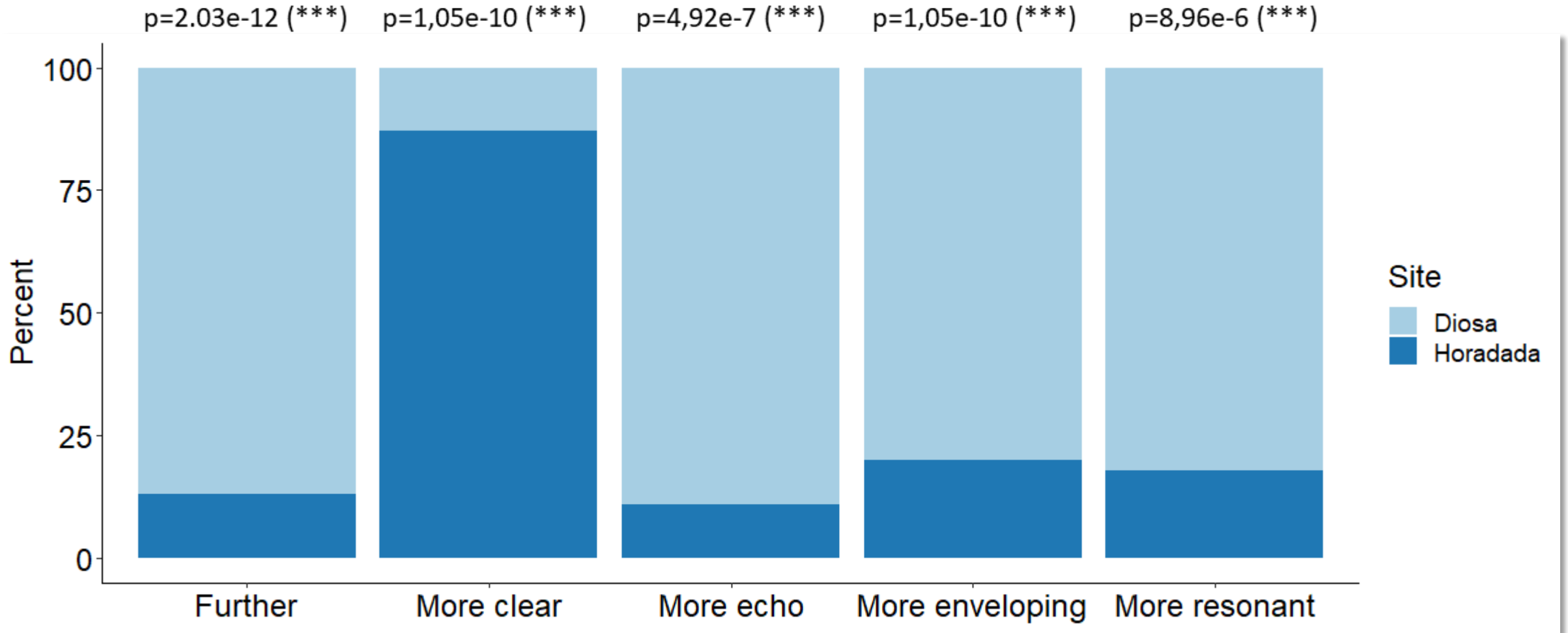
	A	B
...has more echo?		x
...		



- N = 10
- A / B: each sound + 2 IRs
- 10 trials
- Random order of trials
- Random order A / B within trial



Listening test 2: results



- More **clarity** perceived in **HO** significantly more times
- More **echo** perceived in **DI** significantly more times ~ reverberation
- Reverb explains **DI** more **ressonant** and *farther*
- Envelopment?

IRs IDs	T_{20m} (s)	ξ (‰)	C_{80m} (dB)	D_m	G_m (dB)	S-R dist (m)
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- More **clarity** perceived in **HO** significantly more times
 - More **echo** perceived in **DI** significantly more times ~ reverberation
 - Reverb explains **DI** more **ressonant** and *farther*
 - Envelopment?
-
- Consider acoustic perception to hypothesize about purpose of the site during rock art production and re-visits

Thank you!



The Artsoundscapes Team



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Lidia Álvarez-Morales (PostDoc Researcher)



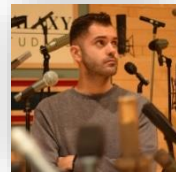
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