

***Interactive comment on* “Developing the hertz art-science project to allow inaudible sounds of the Earth and Cosmos to be experienced” by Graeme J. Marlton and Juliet Robson**

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Reviewer 1: We thank the reviewer for their comments and have provided responses to those comments below.

Anonymous Referee

1 Received and published: 6 April 2020

"The manuscript concerns a project which enabled infra sounds from various sources on Earth to be experienced through a multisensory artistic exhibit. The article focuses primarily on the development process of the exhibit, a collaboration between an artist

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and scientists. This is relevant to the journal *Geoscience Communication* and would be of interest to those thinking of similar projects or approaching art-science collaborations. I do, however, have a number of concerns over the information presented which I detail here. Main issues: The introduction could do with much more of the broader context of science communication and public engagement that concerns this area of science or uses a similar method in order to properly frame this project. At present the motivations that people need to re-establish links with the natural environment come across as merely the opinions of the authors and not backed up by any published research or public dialogues. Only with this wider context is it possible to better consider the successes of this project."

In the revised version of this paper we will modify the introduction section to cite more references to back up the motivations and show how the hertz artwork will sit within the broader context For example: Gupfinger et al (2009), Esquerro and Simon (2019), Hope (2009), Cranshaw (2014).

"The main contribution that this article makes to the literature is arguably the development process of the exhibit. I applaud the authors for writing this in accessible way, however, interested technical readers may want more detailed information. I suggest the authors provide this in an appendix, e.g. giving precise parameters used in their processing so that others may be enabled to convert similar infrasound datasets."

We plan to include a technical appendix which details the filter coefficients used to create the infrasonic sound wave files.

"The evaluation data and its presentation in section 4 are rather lacking unfortunately. There is little to no detail of how "feedback" was collected, what specific questions were asked of participants, and how the qualitative data has been analysed. "

Due to the nature of the tour the co-authors were only present at the first event and were not able to oversee the data collection at the other venues in person. Thus, the feedback received was dependent on the venue in question, for example: At "We the

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Curious” the quality of the feedback received was quite good. However, Tramway’s feedback did not capture the public’s feedback and only that of the organizers. Further to this feedback from the participants was entirely optional and the feedback cards left had little in the way of prompts. In hindsight it may have been better to devise 2 or 3 well defined questions to be asked on the exit of the exhibits.

"To this latter point the authors seem to have simply classified whether or not it was positive and provide, seemingly cherry-picked, example quotes. This work calls out for a thematic analysis to better understand what participants’ responses to this experience were, what common themes emerged and how do they relate to the aims of the project and compare with other similar efforts? Can any conclusion be made linking back to the aims of the project, e.g. did it reconnect participants back with the Earth? "

Given the above highlighted issues with data quality we will rewrite the feedback section and perform a different analysis which would seek to answer, using the data available, Did participants feel more connected with the earth after interacting with the exhibits. This would be undertaken using a thematic approach as suggested by the reviewer.

"While the review of the collaboration is also interesting, more discussion and conclusions need to be drawn from the quotes provided."

The aim of this paper is to describe the motivations, implementation and feedback from the project. We included some detail on the collaboration with a small discussion. It is possible to go into greater depth about this and this may overshadow the work itself. We present our key findings from working together in the collaboration that others can use in a more in depth discussion in the area.

Specific comments: "Throughout the term "resonance" seems to be used slightly carelessly. It is not clear to this reviewer whether it is truly resonances which lead to many of the infrasounds considered (indeed many of them seem to be rather broadband rather than peaking at well defined frequencies), nor is it clear whether the transducers’ vibrations are waves which are resonating within the human body. I would suggest the

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authors consider carefully each usage of this word and only include it where appropriate (e.g. Its usage in describing asteroseismology is correct) and provide references, otherwise other terms such as sound, vibrations etc. should be used."

Yes- the reviewer is correct, resonance is when an object is made to oscillate or vibrate at its natural frequency We will check thoroughly through the text and use the correct scientific descriptions. I.e. vibration, oscillations, frequency etc.

"Line 98: Arguably the enhanced infrasound power goes to a much lower frequency than 0.1Hz in Figure 2, approximately 0.02Hz."

We will amend this in the revised manuscript

"Line 99: LT as Local Time needs to be introduced in the text."

We will amend this in the revised manuscript

"Line 105: There is no visible power enhancement at 1Hz in Figure 4, instead the biggest peaks appears to be around 0.03Hz."

This is a typo, we meant to say the power enhancement is below 1 Hz.

"Line 106: This sentence is confusing. You need to specify what quantity you are referring to exactly and whether you are comparing the two events to one another of the reference in the previous sentence."

We will reword this to highlight that the amplitude of the waveform is less than in figure 3 and the frequency bandwidth is also lower than in figure 3

"Line 123: "documented by smart phone" comes across as though the authors made notes using a smart phone, whereas I understand from later sentences they used an audio recording app on the phone. This should be made clearer."

We will elaborate on this in the revised manuscript: When performing tests we used a smart phone to video the participants response, nominally one of the co-authors,

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interacting with the exhibit rather than attempting to record the exhibit itself.

"Line 137: It is not clear how the amplitude was measured and used to modulate tones. The authors may want to keep such technical detail to the suggested appendix though."

Here a sine wave with a given frequency (60Hz) was generated and then it was multiplied element wise by the band passed filtered infrasonic signal $I(t)$ so that the played sound wave S : $S(t)=I(t)\sin(2*\pi*60*t)$

"Lines 143-160: Polyphonic seems to be the wrong term here, since this is defined as "a type of musical texture consisting of two or more simultaneous lines of independent melody" whereas the authors describe modulated pink noise which is not musical or melodious. What the authors describe is surely more of a cacophony than symphony. It would be very helpful to provide sound clips of the different processed versions of the infrasound for the readers to be able to interpret. Furthermore, on this point, the authors' descriptions of the sounds come across as a little hyperbolic and would benefit from some other viewpoints."

In the amended manuscript we will work on the wording describing the sound waves played. We will add a data repository that will include a sample audio clip that was played on the Radio 3 show so the curious reader can listen. (It should be noted the low pass filter is increased to allow it to be audible through conventional PC speakers)

"Line 167: "practicalities of access needs" are raised but no description or discussion of what these were are given."

More details about how disability access was addressed and incorporated into the project and the motivations behind it will be addressed in the revised Manuscript.

"Line 179-180: "further positive media coverage" is mentioned but no quotes or analysis of the material are presented."

We can include some quotes from the two references in the revised manuscript

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"Lines 247-253: It needs to be stated how all of these were measured."

This data was collected by staff overseeing the exhibit at the venue. This will be amended in the revised manuscript.

"Lines 271-26: The numbers quoted here are rather meaningless without benchmarking against similar efforts. Furthermore, qualitative analysis of any tweets about the exhibit(not merely retweets or likes) could provide insight into audiences' responses, which is currently lacking."

This was an attempt to gauge the social media response online. It seems that this small section adds little and will be retracted in the revised manuscript

"Line 308: This should say Figure 1."

This will be amended in the revised manuscript

"Line 316: It is not clear who did the interviewing."

Marlton was interviewed by Robson as part of the required evaluation for Unlimited's grant evaluation. Robson was interviewed by Liz Hingly <http://lizhingley.com/about> , the project curator for <https://www.phyartuob.co.uk>. This will be added in the revised manuscript

References: Gupfinger, R., 2009, Interactive Infrasonic Environment: A new type of sound installation for controlling infrasound. In Workshop-Proceedings der Tagung Mensch & Computer 2009. Logos Verlag.

Ezquerro, L., and J. L. Simón.,2019, "Geomusic as a New Pedagogical and Outreach Resource: Interpreting Geoheritage with All the Senses." *Geoheritage* 11, no. 3, 1187–98. <https://doi.org/10.1007/s12371-019-00364-3>. Sussman, M.

Hope, C., 2009, "Infrasonic Music." *Leonardo Music Journal* 2009 Vol. 19, 51-56.

Crawshaw, A., 2014, "Towards Defining the Potential of Electroacoustic Infrasonic Mu-

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sic." ICMC

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