# How does bass make us move? Investigating the sensory and physiological mechanisms of very low frequencies' effects on movement.

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## Introduction

- Why does bass in music make us want to dance? Bass is particularly present in dance music, and bass instruments often provide the pulse that we move to.
- When very low frequency (VLF) sound (8-37 Hz) was added to music at a concert, audience members moved more, despite the VLFs being consciously undetectable.[1]
- It is unclear whether VLFs are processed by non-auditory (e.g., tactile) modalities processing and whether physiological arousal may mediate VLFs' movement-boosting effect.
- Here, we compare the effects of VLFs presented to either auditory or vibrotactile systems and across a range of intensities, while measuring subjective ratings, physiological arousal, and spontaneous head movement.

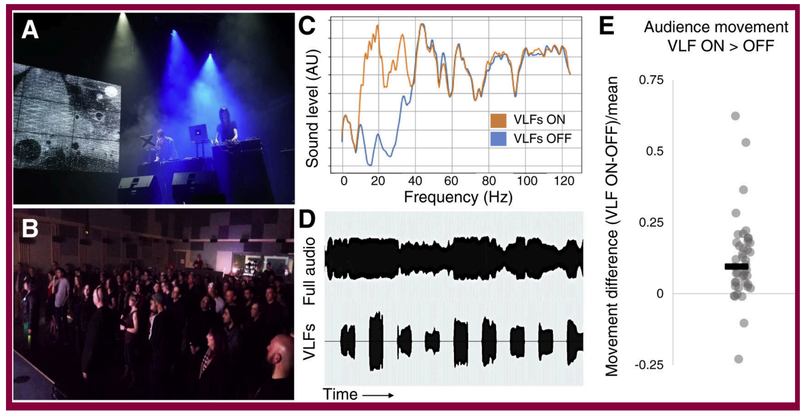


**Figure 1.** A-B) An electronic dance music performance. C-D) VLFs (8-37 Hz) were added to the music for 2.5 min bouts. E) Audience members moved more when VLFs were present vs. absent.[1]

## Research Question

**Does very low frequency (VLF) sound increase the subjective urge to move or physiological arousal during music listening?**
**Which sensory system(s)—auditory and/or tactile—facilitate VLFs' effects?**

## Methods

### Experimental Design

- 4 Pilot participants
- 126 instrumental song clips, 20 seconds in length, all 120 BPM, various genres
- Each song clip presented with VLFs in a 2*4 design (plus a no VLF condition):
  - Auditory VLFs * 4 intensity levels
  - Tactile VLF * 4 intensity levels
- VLFs were the bass content, lowered 2 octaves, and filtered to 8-37 Hz
- Intensities were determined relative to estimated VLF perceptual thresholds ("low" intensity level = estimated threshold), determined by pilot testing
- After each song clip, participants rated urge-to-move and pleasure
- Galvanic skin response, pupillometry, and head movement measured throughout the session

## Methods

### Very Low Frequency Stimulation


**Figure 3.** SUBPAC M2X.[2]

**Figure 4.** Sennheiser IE900 Earphones.[3]

#### Tactile

- Stimulation through the **SUBPAC M2X**[2]; a device that turns bass in music (5-130 Hz) into a vibrotactile sensation.
- Volume of auditory input corresponds to vibrational intensity.

#### Auditory

- Stimulation occurred through **Sennheiser IE900**[3] in-ear headphones.
- Earphones are capable of maintaining the fidelity of VLF audio (frequency response range of 5-14000 Hz).

### Dependent Measures

- **Urge to Move and Pleasure Ratings:** Subjective ratings indicate the concsious urge to move and pleasure associated with the music listening
- **Galvanic Skin Response and Pupil Dilation:** Changes in skin conductance and pupil size indicate autonomic responses
- **Head Acceleration:** Head movements detected by accellerometer in pupillometry glasses indicate spontaneous movement (participants instructed to not move)

## Results

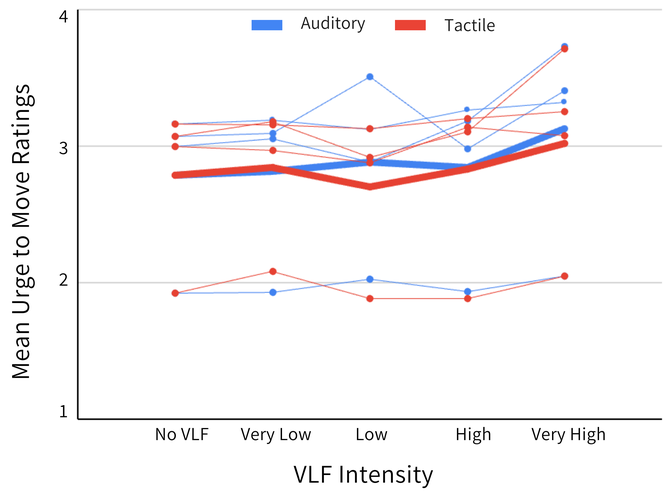


**Figure 5.** Urge to move ratings for Auditory and Tactile modalities and across 4 levels of VLF intensity. Separate lines indicate individual pilot subjects and bold lines indicate group averages.

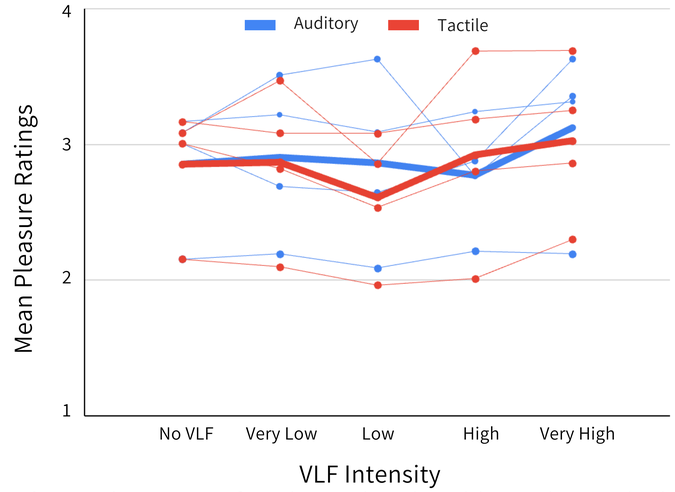


**Figure 6.** Pleasure ratings for Auditory and Tactile modalities and across 4 levels of VLF intensity. Separate lines indicate individual pilot subjects and bold lines indicate group averages.

## Current Findings and Next Steps

**Results will indicate the extent to which VLFs affect physiological arousal, spontaneous movement, subjective urge to move, and subjective pleasure.**

**The relationship between VLF intensity and subjective and physiological measures may help us understand how VLFs can be effective even when they are consciously undetectable.**

## References and Acknolwedgments

1. Cameron, D. J., Dotov, D., Flaten, E., Bosnyak, D. J., Hove, M. J., & Trainor, L. (2022). Undetectable Very-Low Frequency Sound Increases Dancing at a Live Concert. https://doi.org/10.31234/osf.io/qrgzt
2. SUBPAC (2023) [SUBPAC M2X]. Retrieved from: https://subpac.com/subpac-m2x/
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