3:20

2pPP7. fNIRS hyperscanning sheds light on real-world language learning. Xin Zhou (Brain and Mind Inst., The Chinese Univ. of Hong Kong, 4F, Hui Yeung Shing Bldg., CUHK, Shatin, NT 999077, Hong Kong, xinzhou@cuhk.edu.hk) and Patrick Wong (Brain and Mind Inst., The Chinese Univ. of Hong Kong, Hong Kong)

Language acquisition in early childhood occurs through dynamic social interactions, both within familial settings for infants and toddlers and in classroom environments for school-aged children. fNIRS hyperscanning—the monitoring of brain activity in two or more people simultaneously to measure their inter-brain coherence (IBC)—enables researchers to quantify social interaction. Increased IBC can arise both from neural entrainment to shared external cues (e.g., auditory, visual input) as well as by the interplay between self- and other-reference during interaction. We conducted fNIRS hyperscanning studies to uncover the neural mechanisms underlying how young children learn child-directed speech and figurative language conveyed through speech in naturalistic settings. We find how parent-child and peer interactions facilitate language learning outcomes among young children through increased IBC, which was beyond mere presence and neural entrainment. Our research bridges developmental psychology and multi-person neuroscience, offering implications for both family-based and pedagogical approaches to language education.

TUESDAY AFTERNOON, 2 DECEMBER 2025 SOUTH PACIFIC 1, 1:00 P.M. TO 1:45 P.M.

2p TUE. PM

Session 2pSAa

Structural Acoustics and Vibration and Physical Acoustics: Acoustic Polarizability and Low Frequency Scattering

A. J. Lawrence, Cochair
Carderock Div., Naval Surface Warfare Ctr., 9500 MacArthur Blvd, West Bethesda, MD 20817

Nathan P. Geib, Cochair
Appl. Res. Labs., The Univ. of Texas at Austin, 1587 Beal Ave. Apt. 13, Ann Arbor, MI 48105

Chair's Introduction—1:00

Invited Papers

1:05

2pSAa1. Radiation force exerted by progressive waves on a string in terms of polarizability. Chirag A. Gokani (Appl. Res. Labs. and Walker Dept. of Mech. Eng., Univ. of Texas at Austin, 10 000 Burnet Rd., Austin, TX 78758, cgokani@arlut.utexas.edu), Michael R. Haberman, and Mark F. Hamilton (Appl. Res. Labs. and Walker Dept. of Mech. Eng., Univ. of Texas at Austin, Austin, TX)

Polarizabilities represent the response of scatterers in the long-wavelength limit. The present work employs polarizabilities to calculate the radiation force exerted on a scatterer of length a and dimensionless mass density $\mu(x)$ by 1-D progressive waves on a string. The radiation force density equals $\langle \partial S/\partial x\rangle$according to momentum conservation at quadratic order, where the radiation stress S is obtained in the Born approximation in terms of the polarizabilities $\alpha_0 = \int_a \mu(x)\, \mathrm{d}x$ and $\alpha_1 = 2k \int_a \mu(x)\, x\, \mathrm{d}x$, where k is the wavenumber. The radiation force equals $\langle S(a/2)–S(–a/2)\rangle = k^4\xi_0{}^2\tau\alpha_1{}^2/8$, where ξ_0 is the incident wave amplitude and τ is the string's tension. The force agrees with solutions based on Fourier transforms for $ka \ll 1$ [Morse and Ingard, *Theoretical Acoustics* (McGraw-Hill, 1968), Eq. (4.5.17)]. To the order of the present approximation, scatterers with $\mu(x) = \mu(–x)$ do not experience radiation forces due to progressive waves on a string, while scatterers with $\mu(x) = –\mu(–x)$ experience forces on the order of $(ka)^6$. The results elucidate the approximations underlying the more involved calculation of radiation force exerted by progressive acoustic waves [Gokani *et al*., JASA **157** (2025); doi: 10.1121/10.0037572].

1:25

2pSAa2. Acoustic polarizability-based design of time modulated active metamaterials. Bogdan-Ioan Popa (Mech. Eng., Univ. of Michigan, 2350 Hayward St., Ann Arbor, MI 48109, bipopa@umich.edu)

Acoustic metamaterials have enabled new and exciting ways to manipulate acoustic waves but, so far, these structures have seen little practical use. Acoustic applications of interest such as acoustic imaging and sound absorption typically require broadband devices. The passive metamaterials considered in the past have fundamental limitations reducing their usefulness in these applications. Active

metamaterials, on the other hand, are not subject to the limitations of passive media and are thus promising alternatives. However, their development has been slow, owing to a lack of top-down design methods that provide the metamaterial structure needed to achieve desired acoustic properties. This presentation shows that top-down design tools based on acoustic polarizability concepts are perfect for designing such active structures. The efficacy of these tools is demonstrated in experiments featuring metamaterials with programmable acoustic properties including ultra-fast time modulated Willis materials and media with large anisotropic mass density and on-demand principle axis direction.

TUESDAY AFTERNOON, 2 DECEMBER 2025 NAUTILUS I, 2:50 P.M. TO 4:40 P.M.

Session 2pSAb

Structural Acoustics and Vibration and Architectural Acoustics: Building Vibration

Ryuta Tomita, Cochair
College of Sci. & Technol., Nihon Univ., 1-8-14, Kanda, Surugadai, Chiyoda-ku, Chiyoda, 1018308, Japan

Wilson Byrick, Cochair
Pliteq Inc., 131 Royal Group Cresent, Woodbridge, L4H 1X9, Canada

Invited Papers

2:50

2pSAb1. An investigation of the evaluation of subjective responses to simultaneous vertical and horizontal vibrations in residential environments. Yasunao Matsumoto (Dept. of Civil and Environ. Eng., Saitama Univ., 255 Shimo-Ohkubo, Sakura, Saitama 338-8570, Japan, ymatsu@mail.saitama-u.ac.jp), Takashi Morihara (Dept. of Architecture, National Inst. of Technol., Ishikawa College, Tsubata, Ishikawa, Japan), Shigenori Yokoshima (Res. Div., Kanagawa Environ. Res. Ctr., Hiratsuka, Kanagawa, Japan), and Kentaro Hayashi (Benec Vib. and Sound Inst., Edogawa, Japan)

Vibrations induced in buildings by road traffic or railways generally exhibit larger amplitudes in the vertical direction than in the horizontal direction. However, in small-scale buildings such as detached houses in Japan, structural vibration modes of the building dominated in motions in the horizontal direction can be excited, which results in amplifications of horizontal vibrations at upper floors in the building. As a result, both vertical and horizontal vibrations can affect the habitability of those floors. The guideline for evaluating environmental vibrations in buildings published by the Architectural Institute of Japan prescribe evaluation methods for horizontal and vertical vibrations separately by direction. Therefore, there are challenges in applying these methods to evaluate combined vertical-horizontal vibrations. In this study, laboratory experiments were conducted to measure subjective responses to combined vertical–horizontal vibrations. University and college students participated in each experiment using an electrodynamic shaker capable of presenting biaxial, i.e., vertical and horizontal, vibrations to a person on the shaker platform. Input stimuli used in the experiments were generated based on traffic-induced vibrations measured in residential environments. The measured subjective responses were compared with several metrics defined in the current international and national standards.

3:10

2pSAb2. Study on vibration sense evaluation of three-axis combining vibration in actual houses. Toru Matsuda (Defense Structure Improvement Foundation, Yotsuyahonshio-cho, 15-9, Shinjuku-ku, Tokyo 160-0003, Japan, d4-to-matsuda@bsk-z.or.jp) and Ryuta Tomita (Nihon Univ., Chiyoda-ku, Tokyo, Japan)

This study examined a method for evaluating habitability based on vibration sensation in three-axis combining that propagate to the floor of actual houses. The vibration sources are external vibrations from bullet trains and road traffic. The vibration directions are vertical axis, fore-and-aft axis and lateral axis. In Japan, houses are sometimes built near roads or railways. Therefore, traffic vibrations may be felt inside the house. This can lead to complaints. According to a survey by the Ministry of Internal Affairs and Communications in Japan, 90% of complaints about vibration are sensory and psychological. Therefore, it is very important to consider a method for evaluating habitability based on vibration sensation. In Japan, JIS C1510 and AIJES-V0001 have evaluation methods for single-axis vibrations such as vertical and horizontal vibrations. However, there is no method for evaluating vibrations in more than one direction. ISO2631-1 describes an evaluation method for vibrations in more than one direction, but the authors' research has reported that the method in ISO2631-1 may be insufficient. In this paper, we report the results of vibration sensation evaluation experiments carried out using five actual houses, and the evaluation method for vibration in three-axis combining.