APCAM 2023

22nd Annual Auditory Perception, Cognition, & Action Meeting

Thursday, November 16th, 2023

Hilton San Francisco Union Square

San Francisco, CA

8:00am - 5:00pm

Welcome to the 22nd annual Auditory Perception, Cognition, and Action Meeting (APCAM 2023)! Since its founding in 2002, APCAM's mission has been "...to bring together researchers from various theoretical perspectives to present focused research on auditory cognition, perception, and aurally guided action."

APCAM is a unique meeting that blends basic and applied research from different theoretical perspectives and numerous types of auditory stimuli (including speech, music, and environmental sounds). The continued flourishing of APCAM is testament to the openness of its attendees to consider multiple perspectives and value diversity, which is a principle characteristic of scientific progress.

APCAM is affiliated with the journal *Auditory Perception and Cognition* (*AP&C*), which features both traditional and open-access publication options. Presentations at APCAM 2023 are eligible to submit a brief report for consideration in a special issue of *AP&C*. Further information on this opportunity is available from the editors of *AP&C*, Michael Hall (hallmd@jmu.edu) and Mike Russell (mirussell@bellevue.edu). In addition, we encourage you to submit your other work on auditory science to *AP&C*.

APCAM is affiliated with the Auditory Perception and Cognition Society (APCS) (https://apcsociety.org). This non-profit foundation is charged with furthering research on all aspects of audition. The $30 registration fee for APCAM provides a one-year membership for APCS, which includes an individual subscription to *AP&C* and reduced open-access fees for publishing with *AP&C*.

As an affiliate meeting of the 64th Annual Meeting of the Psychonomic Society, APCAM is indebted to the Psychonomic Society for material support. This year we welcome two new sponsors, the online research platform FindingFive and the CMU Department of Psychology, and gratefully acknowledge their financial support of APCAM and APCS.

This year we have a new event in the program, a “Mentoring Meetup.” This will be for anyone interested in being a mentor or interested in being mentored, and offers a chance for prospective mentors and mentees to have a face-to-face introduction, get to know each other, and discuss research areas of interest. If you are a student or young researcher contemplating graduate or postdoctoral plans, or an established researcher looking for students and trainees, this event would be of interest to you.

We appreciate all our colleagues who contributed to this year's program. We thank you for choosing to share your work with us, and we hope you will continue to contribute to APCAM in the future. This year's meeting features a keynote presentation, *The Rhythm of Recovery: A Crescendo in Research on the Impact of Music on Health*, by **Indre Viskontas**; 16 spoken sessions; and 17 posters that cover a wide range of topics in auditory science. We are confident that everyone attending APCAM will find something interesting, relevant, and thought-provoking.

If there are issues that arise during the meeting, or if you have thoughts for enhancing future meetings, do not hesitate to contact any committee member. We wish you a pleasant and productive day at APCAM!

Sincerely,

The APCAM 2023 Organizing Committee

Timothy L. Hubbard (Chair)

J. Devin McAuley

Kathleen C. McCulloch

Krisopher J. Patten

Peter Q. Pfordresher

Hannah Shatzer

Sponsors and Donors

Thanks to our sponsors and donors! (listed in alphabetical order)

Psychology
Carnegie Mellon

https://www.cmu.edu/dietrich/psychology/

FINDING FIVE

https://www.findingfive.com/

PSYCHONOMIC SOCIETY

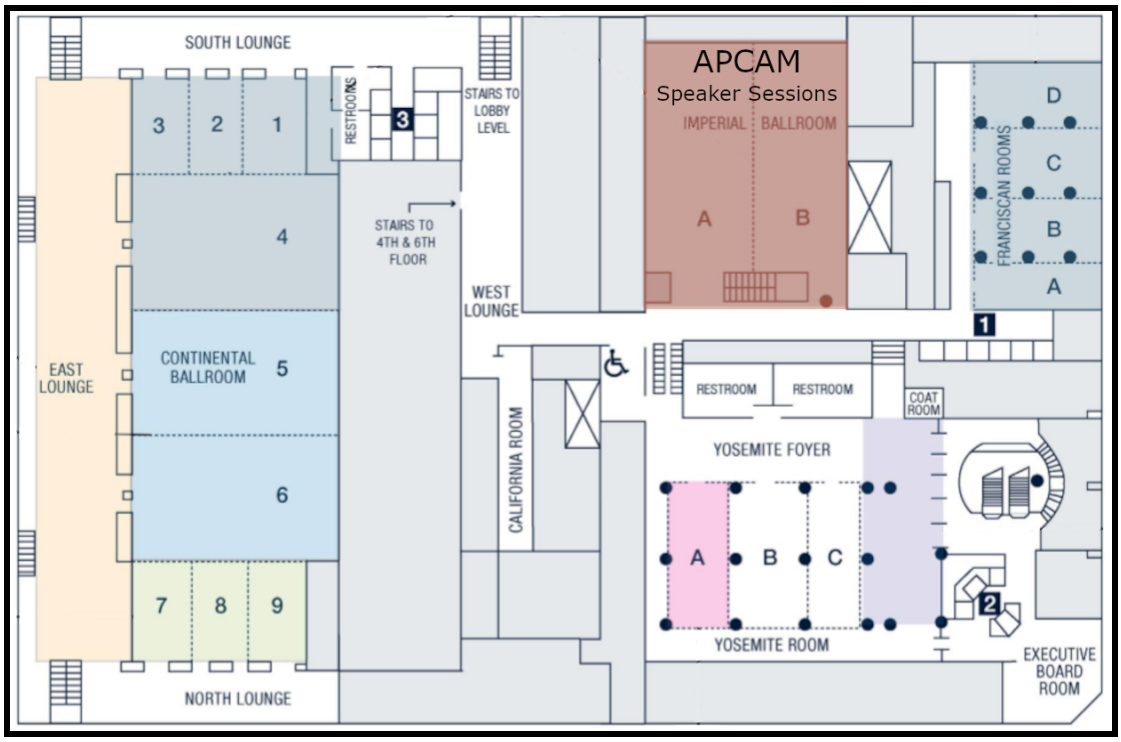
https://www.psychonomic.org/default.aspx

Member donations were made by:

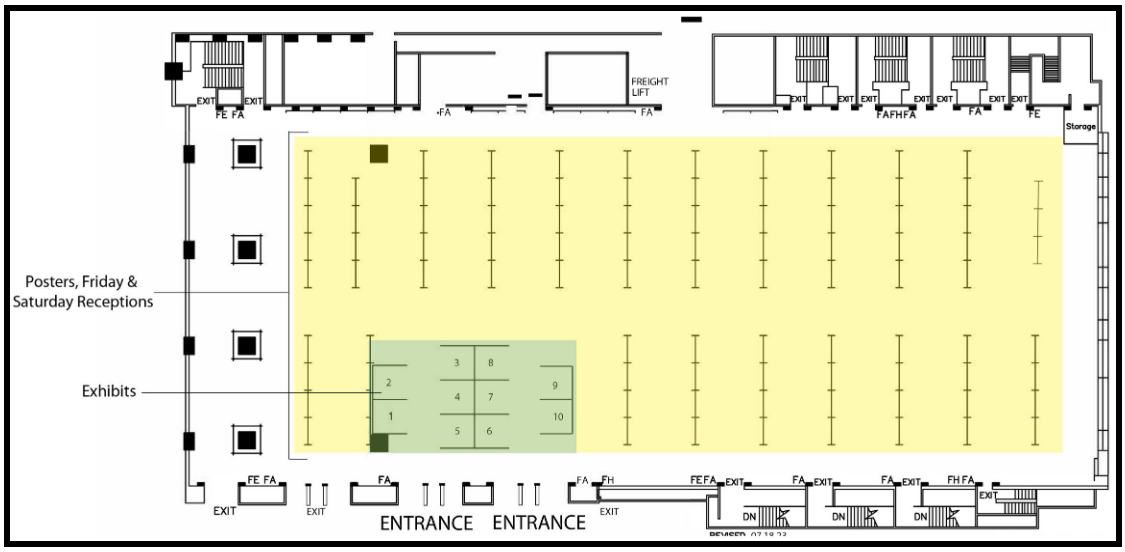
- Melissa Baese-Berk
- Leah Fostick
- Laura Getz
- Laurie Heller
- Hannah Shatzer

Map

Spoken Sessions - Imperial Ballroom
Ballroom Level (2nd Floor)



Poster Session - Grand Ballroom
Grand Ballroom Level (3rd Floor)



Full Schedule

8:00	**Registration**	
8:10	**Welcoming Remarks**	
8:15	**Auditory Scene Analysis Talks**	
8:15	Modulation of brain oscillations related to disambiguation of the auditory context and associated predictions	**Amour Simal**, Université de Montréal; BRAMS
8:30	Ignoring the white bear's roar: Evidence of explicitly-cued distractor suppression in auditory selective attention	**Heather Daly**, The Ohio State University
8:45	hEAR today, gone tomorrow: The relationship between subjective confidence and variability in auditory-based navigation	**Corey S. Shayman and Maggie K. McCracken**, University of Utah
9:00	Reverberation and a sense of the sacred: From archaeo-acoustics to neurotheology	**Timothy L. Hubbard**, Arizona State University
9:15	**Membership Meeting**	
9:45	**Break**	
10:00	**Music Talks**	
10:00	Harmony syntactic function emerging from sequential scale notes in a diatonic mode: An event-related potential study	**Shicheng Zhang,** Stanford University
10:15	The influence of dissonance and register on listeners' perceived emotions in rhythmically complex musical excerpts	**Ève Poudrier**, University of British Columbia
10:30	Validation of a gamified music training to improve sensorimotor skills in children with autism	**Kevin Jamey**, University of Montreal, BRAMS, CRBLM
10:45	Impact of absolute pitch on auditory learning	**Erica R. Knowles**, Berklee College of Music

11:00	**Break**	
11:15	**Keynote: Indre Viskontas, University of San Francisco** *The rhythm of recovery: A crescendo in research on the impact of music on health*	
11:45	**Lunch**	
1:15	**Poster Session**	
1:15	Poster set-up	
1:30	Poster session	
2:45	**Speech Talks**	
2:45	Catching the first pitch: A proposed dynamic functional network of linguistic prosody	**Corianne Rogalsky**, Arizona State University
3:00	Investigating the consistency and determinants of speaker memorability	**Cambria Revsine**, University of Chicago
3:15	Persistence effects on degraded speech	**Sridhar Krishnamurti**, Auburn University
3:30	**Mentorship Meeting**	
3:45	**Break**	
4:00	**Language Talks**	
4:00	Natural language processing of auditory perceptual experiences: A content-analytic approach	**Nathan F. Gillespie**, University at Albany, SUNY
4:15	Online language processing and listening effort in the face of unexpected talker information	**Sarah Colby**, University of Iowa
4:30	Hearing from multiple talkers affects types of errors produced by learners, but not accuracy rate	**Shiloh Drake**, University of Oregon
4:45	Effects of task language on English and Spanish bilinguals' speech perception	**Laura Getz**, University of San Diego

Poster Session

1	**APCAM Sponsor**	
1	The future of research is online: Empowering behavioral research with FindingFive	**Noah Nelson**, FindingFive
2-6	**Speech**	
2	Listening effort across multilingual language: Interplay with cognitive ability and proficiency	**Dana Bsharat-Maalouf**, University of Haifa
3	The role of valence and speaker identity in false hearing	**Ummi Coats**, Union College
4	The effects of background noise on aperiodic neural activity during speech perception	**Sarah J. Woods**, University of Utah
5	Selective attending to human voices: Evidence from detections and pupillary responses	**Merve Akça**, University of Oslo
6	Listening effort exerted in eateries	**Mahnoor Javed**, Toronto Metropolitan University
7-10	**Music**	
7	Masculine and androgynous dress as a coping mechanism for non-male populations in jazz performance	**Anna Fortuna**, Berklee College of Music
8	The long-term stability of the speech-to-song illusion and the effects of individual differences	**Rodica R. Constantine**, University of Nevada, Las Vegas
9	Listeners detect deviant beats better in musical rhythm contexts with fewer subdivision levels: An MMN and behavioral study	**Julia Yu**, Stanford University
10	Influence of spectral envelopes on the pitch of Shepard tones	**Michael D. Hall**, James Madison University

11-13	Auditory Scene Analysis	
11	Perception of global properties, objects, and settings in natural auditory scenes	**Margaret McMullin**, University of Nevada, Las Vegas
12	Auditory perception of occlusion: Impact of obstruct size	**Michael K. Russell**, Bellevue University
13	Effects of acoustic and visual motion on loudness change	**Maggie K. McCracken**, University of Utah
14-15	**Cross-Modal Perception**	
14	Exploring modality differences in recognition memory: Repetition effects on recollection and familiarity	**Sharica Lee**, University of Nevada, Las Vegas
15	When and why can visual information increase sound pleasantness?	**Laurie M. Heller**, Carnegie Mellon University
16-17	**Healthy and Disordered Hearing**	
16	The relationship between hearing screenings and anxiety, depression, and sleep	**Chris Koch**, George Fox University
17	Cortical tracking of visual and auditory information in children with cochlear implants	**Tatiana Matyushkina**, University of California, Davis

Diversity, Equity, and Inclusion Committee Updates

Members: Laura Getz (Chair), Emma Greenspon, Laurie Heller, CJ Joyner, Jenny Roche

Membership Demographic Survey

The DEI committee is assessing the needs of our members and addressing concerns related to diversity and equity within our community by completing a membership survey. The purpose of this survey is to gather information about the identities, backgrounds, and experiences of APCS members. This survey is anonymous, and data will be analyzed in aggregate to protect confidentiality of responders. These results will be shared with the DEI committee and APCS board to help assess the needs of the APCS community and establish actionable goals to support underrepresented scholars in auditory science. This survey will take approximately 10 minutes to complete. Answers to all questions are optional, but we would greatly appreciate your feedback!

Link here or scan the QR code: https://forms.gle/9rttRt23Vbe72xB7A

2023 Diversity Award Recipients

More information: https://apcsociety.org/dei-awards.html

Travel Award: $500 travel award for undergraduate or graduate students from underrepresented populations broadly defined.

- Sarah J. Woods (University of Utah)

Membership Award: free registration for participants with financial need regardless of rank.

- Merve Akça (University of Oslo)
- Dana Bsharat-Maalouf (University of Haifa)
- Ummi Coats (Union College)
- Nathan F. Gillespie (University of Albany)
- Sharica Lee (University of Nevada Las Vegas)
- Maggie K. McCracken (University of Utah)

Talk Abstracts

Auditory Scene Analysis (8:15-9:15)

8:15 Modulation of brain oscillations related to disambiguation of the auditory context and associated predictions

Amour Simal*	Université de Montréal; BRAMS
Robert Zatorre	Montreal Neurological Institute; McGill; BRAMS
Pierre Jolicoeur	Université de Montréal; BRAMS; CRIUGM

Accurate predictions and the processing of prediction error signals can be important for efficient interaction with the auditory environment. We sought to identify new electrophysiological indicators associated with disambiguation of the hearing context and prediction of forthcoming stimulation by reanalyzing previous data (Simal et al., 2021). Participants heard two isochronous sequences of pure tones separated by a silent retention interval and had to indicate whether they were the same or different. A sequence could contain one, three, or five tones. Fifteen participants heard the three conditions randomly intermixed. In this case, when sequence length was unpredictable, the second and fourth tone during encoding contained information allowing the prediction of another tone. A second group heard the sequences blocked by sequence length, so the second and fourth tone of the sequences provided no new information. Informative tones elicited increased N1 and P2 event-related potential (ERP) components. Using wavelet analysis, we found a significant increase in theta (4 – 7 Hz) amplitude following a tone that was informative and allowed prediction, in comparison with a tone that carried no predictive information. Previous work suggests increased theta amplitude is linked with task switching and an increase in cognitive control. We suggest informative tones recruit higher-level control processes involved in prediction of upcoming auditory events.

Author e-mail: amour.simal@umontreal.ca

Back to Schedule

8:30 Ignoring the white bear's roar: Evidence of explicitly-cued distractor suppression in auditory selective attention

Heather R. Daly* The Ohio State University
Mark A. Pitt The Ohio State University

Don't think of a white bear. Are you now thinking of a white bear? While it seems like it should be helpful to know something about an upcoming distractor, research has shown that cueing a distractor feature tends to draw attention to that feature rather than making it easier to ignore (e.g., Tsal & Makovski, 2006). However, more recent visual research has demonstrated that individuals can ignore a cued distractor, as long as they have sufficient time to prepare (Moher & Egeth, 2012). It is unknown whether this is the case for auditory distractors. The present investigation tested whether individuals could use a pre-trial cue to ignore an upcoming auditory distractor. Participants listened to scenes consisting of several voices saying a series of digits and one of six possible distracting animal sounds. They were instructed to use a cue to ignore the distractor while searching for the gender singleton voice. Responses were faster when the distractor was cued relative to when it was unexpected, suggesting that individuals can use cues to help them ignore irrelevant distracting sounds. To evaluate whether this explicitly-cued distractor suppression is distinct from implicitly-learned suppression where listeners learn to suppress frequently-occurring distractors in their environment (Daly & Pitt, 2021), a new group of participants was asked to complete both suppression tasks. Results revealed no correlation between the two suppression effects, indicating that the two forms of suppression are likely distinct mechanisms that rely on unique cognitive resources. Together, these results demonstrate that even in audition, it is possible to use a cue to suppress an upcoming distracting sound, and that this explicitly-cued suppression seems to be distinct from suppression based on implicit learning of statistical regularities.

Author e-mail: daly.134@osu.edu

Back to Schedule

8:45 hEAR today, gone tomorrow: The relationship between subjective confidence and variability in auditory-based navigation

Corey S. Shayman*	University of Utah
Maggie K. McCracken*	University of Utah
Linden C. Carter	University of Utah
Hunter C. Finney	University of Utah
Jeanine K. Stefanucci	University of Utah
Sarah H. Creem-Regehr	University of Utah

Numerous available sensory cues can be used to guide navigation. Those generally argued to have the greatest impact are visual cues (both optic flow and landmarks) and vestibular and proprioceptive cues (also known as body-based self-motion cues when grouped). Auditory cues may also play a role but their impact is not as well understood. Further, navigation is an inherently noisy everyday task, and our ability to use these sensory cues to guide performance can be imprecise. In a quest to understand how to improve navigation performance with spatial auditory cues, we tested how much people trust their auditory-based navigation abilities relative to their other senses as well as relative to their actual navigation performance (accuracy and variability). Healthy, young participants were asked to navigate two outbound paths and then return to home with auditory cues only, visual cues only, or visual + auditory cues available to them. Variability in locating home and self-reported confidence in reaching the home location were measured. Because variability has traditionally served as a way to measure perceptual noise, we compared individuals' self-reported confidence to navigation variability to better understand whether subjective confidence is proportional to noise. Participants were less confident in their auditory-only performance than in their other cue conditions and their subjective confidence negatively correlated with their auditory-only variability in performance . This means that as confidence increased, variability decreased. These results suggest that navigators have some metacognitive insight into their ability to use their hearing to wayfind. No relationship was seen between visual or audiovisual confidence and variability. We suggest that auditory information can provide valuable feedback for calibrating navigation ability to lead to more precise performance when other senses are possibly impaired or reduced.

Author e-mail: corey.shayman@hsc.utah.edu

Back to Schedule

9:00 Reverberation and a sense of the sacred: From archaeo-acoustics to neurotheology

Timothy L. Hubbard* Arizona State University

Auditory stimuli are an important component of religious activity and experience (e.g., chanting, hymns, etc.), and an important quality of auditory stimuli is reverberation (i.e., the perceived persistence of a sound due to multiple reflections from nearby surfaces), which reflects a combination of the characteristics of the sound source and the characteristics of the environment. Studies of pre-historic and historic sacred sites (e.g., Lascaux and other painted caves, Göbekli Tepi and other excavated sites, Stonehenge and other monolithic sites, Notre Dame and other Gothic cathedrals) found relatively long auditory reverberation times, and this is consistent with the possibility that consideration of acoustic properties such as auditory reverberation time were important in the selection or construction of such sites. Why might this occur? In humans, significant auditory processing occurs in the temporal lobes, and it is possible that longer auditory reverberation times are linked with increased stimulation of the temporal lobes. Some studies have suggested that increased stimulation of the temporal lobes is linked with an increased sense of the sacred or otherworldly (e.g., the "god module"). Thus, it is possible that a sense of the sacred or otherworldly is evoked within individuals in sacred sites in part by the presence of increased auditory reverberation. As auditory reverberation reflects both the sound source and the environment, perception of increased reverberation might be implicitly linked to an increased sense of connection with the sound source. Additionally, auditory reverberation might provide dynamic information regarding the stimulus. Thus, consideration of auditory reverberation could have important implications for theories of cognitive dynamics and theories of neurotheology.

Author e-mail: timothyleehubbard@gmail.com

Back to Schedule

Music (10:00-11:00)

10:00 Harmony syntactic function emerging from sequential scale notes in a diatonic mode: An event-related potential study

Shicheng Zhang* Stanford University
Takako Fujioka Stanford University

In Western tonal music, chords containing 3 or 4 notes selected from a scale provide the foundation of harmony and its associated syntactic rules. In modern jazz, scales are further associated with specific chords, termed 'chord-scale theory.' Previous research demonstrated that a syntactically irregular chord elicits early right anterior negativity (ERAN) and N5 responses, as neurophysiological correlates of harmonic expectation in the human brain.

The current study examined if and how a diatonic scale plays a specific harmonic function to contribute to the ongoing syntactic structure. We hypothesized that the pitch classes and their distance to the tonal context together influence the interpretation of the target chord. For example, a Neapolitan sixth chord in the key of C (Db-major, F, Ab, and Db) is incongruent with C Ionian in terms of the pitch classes but congruent with both C Locrian and C Phrygian. Furthermore, this chord following C Locrian might induce an increased sense of resolution because the scale's local tonality makes the target chord tonic, compared to C Phrygian, which makes the target chord non-tonic. For EEG recording, participants passively listened to stimulus sequences, each consisting of Prime A (chords) + Prime B (ascending scale notes) + Target (a chord) such that Prime A and B set up global and local tonality, respectively.

Our data showed that ERAN and N5 amplitudes at the target chord are indeed affected by (1) the implied harmonic degree of the local tonality and (2) the distance between the local and global tonality in the circle of the fifth space. These results suggest that Western listeners' brains can dynamically interpret diatonic mode scale notes as part of harmony processing and update the tonal music contexts to incorporate upcoming music parts.

Author e-mail: sczhangb@stanford.edu

Back to Schedule

10:15 The influence of dissonance and register on listeners' perceived emotions in rhythmically complex musical excerpts

Ève Poudrier*	University of British Columbia
Bryan Jacob Bell	University of British Columbia
Jason Yin Hei Lee	McGill University
Craig Stuard Sapp	Stanford University; CCARH; PHI

This study investigates the influence of acoustic dissonance on listeners' ratings of five emotional dimensions (mood, energy, movement, dissonance, and tension), using excerpts from keyboard compositions featuring complex rhythmic structure. Dissonance was operationalized as randomized pitches from four scales: pentatonic major, diatonic major, whole-tone, and chromatic. Register presentation of contrasting rhythmic groups within each excerpt was counterbalanced, while rhythmic structure was held constant, resulting in 64 distinct stimuli (8 excerpts × 4 scales × 2 register conditions). To assess the influence of musical structure on listeners' perceived emotion, eight rhythm and pitch measures were extracted: duration, composite event density, event density ratio, nested ratio, polarity ratio, nPVI group difference, pitch mean, and sonority dissonance. The results show a main effect of scale, but not register. Diatonic major, whole-tone, and chromatic excerpts were rated as more negative in mood and more dissonant than pentatonic major. Whole-tone and chromatic excerpts were also perceived as more negative and more dissonant than diatonic major, as well as more tense and less likely to induce movement than both pentatonic major and diatonic major. There was no significant effect of scale type on energy. Several rhythmic and pitch features were reliable predictors of listener's ratings. Rhythmic factors were predictive of mood, energy, and movement ratings, with an increase in rhythmic complexity being associated with a more negative mood, lower arousal, and less impulse to move along the music. On the other hand, longer and rhythmically denser excerpts, as well as those with more coinciding events between rhythmic groups, were perceived as more positive, more energetic, and more likely to induce sensorimotor synchronization. Sonority dissonance was a reliable predictor of subjective dissonance and perceived tension, thus providing support for the use of pitch randomization of naturalistic source materials to assess the influence of dissonance on perceived emotion.

Author e-mail: eve.poudrier@ubc.ca

Back to Schedule

10:30 Validation of a gamified music training to improve sensorimotor skills in children with autism

Kevin Jamey*	International Laboratory for Brain, Music, and Sounds Research (BRAMS); University of Montreal; Centre for Research on Brain, Language, and Music (CRBLM)
Hugo Laflamme	BRAMS; University of Montreal; CRBLM
Nick E. V. Foster	BRAMS; University of Montreal; CRBLM
Simon Rigoulot	BRAMS; University of Montreal; CRBLM; University of Quebec at Trois-Rivières
Krista L. Hyde	BRAMS; University of Montreal; CRBLM
Simone Dalla Bella	BRAMS; University of Montreal; CRBLM

Children on the autism spectrum present sensorimotor difficulties which are linked with their cognitive and social impairments. Training sensorimotor synchronization in this population may generalize to other sensorimotor domains and beyond (e.g., executive functioning and social skills). To test whether sensorimotor skills can be trained in children with autism, we conducted a feasibility study using sensorimotor synchronization (SMS) training in the form of a musical serious game: "Rhythm Workers" (RW). We administered an at-home longitudinal protocol across Canada in children with an autism diagnosis (excluding co-morbidities). Twenty-four children (7-13 years) were randomly assigned to either a finger-tapping rhythmic game (RW) or a control game (active control condition) with similar auditory-motor demands except beat-synchronization. Participants played the game for 300 minutes over 2 weeks. We collected data (self-reported and logged on the device) reflecting the game usability, compliance, and appreciation. Additionally, we tested rhythmic abilities using selected tasks from the Battery for the Assessment of Auditory Sensorimotor and Timing Abilities (BAASTA). Preliminary findings show that both games were played close to the target time ($p > 0.16$), rated similarly for perceived difficulty and motivation ($p > 0.23$), and were comparable in terms of motor activity (n. of finger taps; $p = 0.51$). The children who played RW improved more than a third of a SD ($M = 0.34$, $SD = 0.46$) in rhythmic production abilities ($p < .05$), and these improvements were positively related to playing duration ($p < .05$). We did not find any such improvements in those playing the control game. Our findings suggest that both games are well-matched and that only RW improves sensorimotor skills in children on the autism spectrum.

Author e-mail: kevin.jamey@umontreal.ca

Back to Schedule

10:45 Impact of absolute pitch on auditory learning

Erica R. Knowles*	Berklee College of Music
Mateo Larrea	Berklee College of Music
Sheena Odabashian	Berklee College of Music
Mi-Lan Hoang	Berklee College of Music
Ella Shalev	Berklee College of Music

Auditory learning is a key component of musicianship, and this ability is shaped over the course of music training. While research has demonstrated that previous experience can shape perception and therefore acquisition, the role of established pitch representations on auditory learning has not been considered. Absolute pitch (AP), colloquially known as perfect pitch, is the ability to name the chroma (pitch class) of an isolated tone or produce the pitch of a specified note in the absence of an external reference. This ability contrasts with relative pitch (RP) in which pitch-processing is based upon relationships between tones. The current research sought to investigate the impact of established pitch representations on auditory learning using a well-established auditory statistical learning paradigm across two tuning conditions. One condition was congruent with established pitch representations (i.e., Western tuning) and the second condition was incongruent with prior training experience (i.e., Bohlen-Pierce tuning). AP ability conferred an advantage when the tuning system was congruent with the learned associations. AP musicians significantly outperformed their RP musician peers in the Western tuning condition. However, in the incongruent condition, AP musicians no longer showed an advantage and performed on par with the RP musicians. Overall, our results demonstrate that while previously established pitch representations can impact the ability to learn from the auditory environment, there is some flexibility to the strategies used during acquisition.

Author e-mail: eknowles@berklee.edu

Back to Schedule

Keynote (11:15-11:45)

The rhythm of recovery: A crescendo in research on the impact of music on health

Indre Viskontas* University of San Francisco

In this talk, Dr. Indre Viskontas charts the exponential rise of research into the intricate relationship between music and our health and wellbeing. Along the way, she will unveil the profound ways in which music can enhance our lives by drawing upon cutting-edge research and her own expertise as a neuroscientist and musician, as well as her work as the Director of Communications at the Sound Health Network, an initiative of the National Endowment for the Arts in partnership with UCSF, and in collaboration with the National Institutes of Health, the Kennedy Center for the Performing Arts and soprano Renée Fleming. With eloquent storytelling and scientific rigor, she illuminates how music's therapeutic qualities can mitigate stress and pain, stimulate creativity, and even rewire the brain after injury.

Author e-mail: indre.viskontas@gmail.com

Back to Schedule

Speech (2:45-3:45)

2:45 Catching the first pitch: A proposed dynamic functional network of linguistic prosody

Corianne Rogalsky* Arizona State University
Arianna N. LaCroix Purdue University

Linguistic prosody is a critical component of speech planning in neurotypical adults, and has been recognized as a common impairment in individuals with aphasia and apraxia of speech. Yet, the impact of linguistic prosody abilities on speech comprehension remains unclear at best or disregarded at worst, with the majority of prosody research focusing on the right hemisphere and emotional prosody. Although there is a wealth of evidence that linguistic prosody is supported by the left hemisphere, linguistic prosody-specific neural circuitry remains elusive and there are currently (to our knowledge) no testable neuroanatomical models of linguistic prosody. In this presentation, we will present our functional neuroanatomical model of linguistic prosody (the first to our knowledge). Our work and others suggest that a neuroanatomical model of linguistic prosody should be able to predict speech comprehension abilities based on interactions between auditory attention frontal-parietal networks that support pitch detection and orientation, and traditional peri-Sylvian language regions. Our left dorsal speech prosody model is based on recent research indicating that (i) linguistic prosody significantly aids degraded speech comprehension, (ii) linguistic prosody is supported by neural resources outside of classical language areas, and (iii) auditory pitch detection and attention abilities correlate with the use of prosodic cues during speech comprehension. Our model proposes that linguistic prosody is supported via functional connectivity between dorsal frontal-parietal auditory attention resources (for pitch detection and orientation) and more ventral phonemic speech networks. We predict that the dynamic functional connectivity between the dorsal speech prosody network and the more ventral phonemic network supports the use of prosodic cues in speech comprehension. Potential alternative models and empirical tests of the model also will be discussed. We aim to provide a new roadmap to answer critical foundational questions about the neurobiology of speech comprehension.

Author e-mail: corianne.rogalsky@asu.edu

Back to Schedule

3:00 Investigating the consistency and determinants of speaker memorability

Cambria Revsine*	University of Chicago
Wilma A. Bainbridge	University of Chicago

Memorability, or the likelihood of a stimulus to be remembered, is an intrinsic property of stimuli that is highly consistent across people. In other words, participants tend to remember and forget the same faces (Bainbridge et al., 2013; Bainbridge, 2017), scenes (Isola et al., 2014), visual noise images (Lin et al., 2021), and more. However, memorability research until now has been entirely limited to the visual domain. We provide the first exploration of auditory memorability, investigating whether this consistency in what individuals remember and forget extends to speakers' voices, and if so, what makes a voice memorable. Over 2500 online participants performed a continuous recognition task in which they heard a sequence of the same sentence read by different speakers from the TIMIT database (Garofolo, 1993), and indicated whenever they heard a repeated voice. In two versions of the task that differed in the sentence used as stimuli, we found that participants were indeed significantly consistent in their memory performance for voice clips. We also observed a significant correlation between memorability scores (d') for the two sentences of the same speakers, suggesting consistent memorability at the level of the speakers beyond specific utterances. Next, we ran regression models incorporating both low-level properties (e.g., fundamental frequency, harmonic amplitude) and high-level properties (e.g., dialect, perceived confidence) to predict the memorability of both sentences separately. The final models, which contained primarily low-level predictors, were significantly predictive of d'. Critically, both models successfully cross-validated to stimuli of the other sentence, providing further evidence that the memorability of speakers is intrinsic and predictable. Overall, our findings can be used to control for the memorability of stimuli in auditory experiments, and more generally shed light on the processes of speech perception and memory.

Author e-mail: crevsine@uchicago.edu

Back to Schedule

3:15 Persistence effects on degraded speech

Sridhar Krishanmurti*	Auburn University
Susan Teubner-Rhodes	Auburn University
Rebecca Dunterman	Auburn University

Complex adverse listening conditions for speech intelligibility (background noise, rapid speech etc.) often require more top-down processing involving the cingulo-opercular network. Pupil dilation is an objective measure that can track the listening effort associated with speech intelligibility for young, middle-aged, and older adults. Because the pupil response reflects cortical inputs to the autonomic nervous system, increases in pupil dilation indirectly measure the attention system's response to increasing task demands. The present study examines how persistence affects accuracy and pupil dilation (i.e., listening effort) during recognition of time-compressed speech in healthy younger and older adults. We report results from 23 younger and older adults who completed the Wisconsin Card Sorting Task-64 [6] to assess individual differences in shifting and persistence. Participants underwent a vision screening and a standard audiological assessment. Then, they completed a speech recognition task. On each of 36 trials, participants listened to and repeated 4 words presented at time-compression rates of 0% (normal speech), 30% (rapid speech), and 60% (very rapid speech). Pupil diameter was measured during listening using Micromedical Video Nystagmography goggles, in an illumination-controlled environment. Analyses examined the peak pupil diameter in 1-second increments from speech onset. Recognition accuracy was 8% higher for 0%-compressed versus 30%-compressed words than 30%-compressed versus 60%-compressed words. In individuals with higher persistence, pupil dilation increased linearly from 0% to 30% to 60% compression, with peak dilation occurring 2-3 seconds after trial onset. In contrast, individuals with lower persistence exhibited maximal pupil dilation in the 30% condition, peaking 4-5 seconds after trial onset. Results suggest that persistence affects the extent to which individuals continue to exert effort as speech rate increases. Those with lower persistence exhibit a drop-off in a physiological index of listening effort as speech rate rises, suggesting that these individuals may be vulnerable to speech comprehension deficits.

Author e-mail: krishsr@auburn.edu

Back to Schedule

Language (4:00-5:00)

4:00 Natural language processing of auditory perceptual experiences: A content-analytic approach

Nathan F. Gillespie* University at Albany, SUNY
Gregory E. Cox University at Albany, SUNY

Most recent research in auditory cognition focuses on quantitative outcome variables like recognition accuracy and similarity ratings. These outcome variables are not always enough, however, to understand individual differences in perceptual strategies and experiences. The present study begins to address this gap by examining trends in narrative answers to questions about which strategies participants employed in similarity rating and recognition judgment tasks for a set of novel auditory stimuli. We applied topic modeling to a sample of 240 written responses from 3 different experiments to questions about: 1) how participants compared sounds to one another; 2) how participants encoded sounds in memory; and 3) participants' impressions of the sounds they heard. Cross-validation showed that 9 topics were sufficient to characterize people's similarity responses, while 5 accounted for the variance in their recognition judgements. 40 topics captured the impressions people had of the sounds that they heard. Principal components analysis of the resulting topic distributions found that similarity strategy topics clustered into three distinct themes: Verbal Labels, Featural Separation, and Effort. Recognition strategy topics clustered into three themes: Mental Imagery, Effort, and Featural Comparison. Impressions of the artificial auditory stimuli clustered into two themes: Machinery, and Electricity. Individual differences in the relative prominence of these topics was related to variance in performance on a variety of auditory memory and perception tasks. Results will be discussed, with the goal of proposing a methodology for triangulating quantitative, qualitative, and computational methods in auditory research.

Author e-mail: ngillespie@albany.edu

Back to Schedule

4:15 Online language processing and listening effort in the face of unexpected talker information

Sarah Colby* University of Iowa
Bob McMurray University of Iowa

To successfully process language, listeners must accommodate variation in production across talkers. Talker variability can be beneficial for learning wordforms and speech sounds, but may also have a processing cost in terms of response time. However, this work has not examined its effects on the real-time dynamics of lexical processing. We asked whether unexpected changes in the talker disrupt online lexical access when listeners must adapt to a talker to cope with phonetic ambiguity (Experiment 1) or use talker information to segregate speech and noise (Experiment 2). In Experiment 1, participants (N=42) heard sentences directing them to select a target word from a display while their eye movements were tracked. For 1/3 of the sentences, the target word was spoken by a different talker than the carrier sentence (e.g., a female target with a male carrier sentence). The vowels in the target words were always ambiguous in height—an acoustic cue that is important for vowel identity, but also varies systematically based on talker gender. In Experiment 2, participants (N=40) completed the same task with a similar talker manipulation, but sentences were embedded in 0 SNR babble (and vowels were unmanipulated). In both tasks, no effect of talker mismatch was found, suggesting robust language processing in the face of talker variability. In Experiment 3, participants will complete a similar task to Experiment 1, but with modifications to assess change in pupil size. Data collection is ongoing, but we will investigate whether there is increased listening effort during language processing with variable talkers. This would confirm that online language processing is robust to unexpected talker information, but at the cost of increased listening effort.

Author e-mail: scolby@uiowa.edu

Back to Schedule

4:30 Hearing from multiple talkers affects types of errors produced by learners, but not accuracy rate

Shiloh Drake* University of Oregon
Melissa M. Baese-Berk University of Chicago

This study explores how auditory stimuli from multiple talkers affects learning of morphophonological alternations in an artificial grammar. Hearing words from multiple voices creates more robust lexical representations (e.g., Davis & Gerken, 2013, 2014; Rost & McMurray, 2009, 2010) and aids generalization to new grammatical structures (Gonzales et al., 2018) and accents (Baese-Berk et al., 2013; Bradlow & Bent, 2008). Hearing multiple auditory representations of the same linguistic segments therefore seems to be beneficial to learners across multiple domains of language.

In our work, participants heard either three different voices or three repetitions from the same voice when learning singular and plural forms in two artificial grammars. To investigate whether the familiarity of word formation patterns (i.e., morphology) also affected learning in the two talker conditions, one artificial grammar was modeled on English morphology, while the other was modeled on Arabic morphology.

Participants responded more accurately in the English-like grammar than in the Arabic-like grammar. However, within each grammar type, there were no significant differences between the accuracy rates of the participants who heard only one talker compared to the participants who heard three different talkers. The number of talkers did affect which error types were more common: Participants in the single-talker condition were more likely than those in the multitalker condition to use particular suffixes or add extraneous vowels in the Englishlike grammar. Participants in the Arabiclike grammar in the single-talker condition were more likely to change consonants and use different CV skeleta than those in the multitalker condition.

Our results suggest that, when learning morphology, different talker conditions cause learners to focus on different parts of an utterance, but do not ultimately affect the accuracy of learning overall.

Author e-mail: sdrake@uoregon.edu

Back to Schedule

4:45 Effects of task language on English and Spanish bilinguals' speech perception

Laura Getz* University of San Diego

Variability across speakers and across languages makes speech perception a surprisingly complex task, as there are not exact numerical values you can memorize to determine what speech sound someone is intending at any given time without understanding the speaker context. For example, one acoustic cue is voice onset time (VOT), a measure for the length of different stop consonants. In English, voiced stop consonants like /b/ have short VOTs (around 0ms) and voiceless stop consonants like /p/ have longer VOTs (around 40ms). In Spanish, the same sounds are shifted in VOT, such that /b/ is pre-voiced with a VOT around -40ms and /p/ has a VOT around 0ms. Thus, an English voiced phoneme and a Spanish voiceless phoneme have identical VOTs. This is especially relevant for bilingual speakers, who need to know the rules for phoneme pronunciation in multiple languages. The specific goal of our research project was to investigate how bilingual English-Spanish speakers shift their perceived VOT boundary based on language context. Researchers interacted with participants in either all English or all Spanish, and then participants completed an experiment where they were asked what they heard for a variety of pairs of words/non-words that exist in English and/or Spanish (e.g., basta/pasta where both are words in Spanish but only pasta is a word in English). We found VOT perception differences between participants completing the task in English and Spanish, especially at intermediate VOTs. However, results were not as robust as expected, and have led us to follow a growing trend in bilingualism research to understand qualitative experiences, individual differences, and participant perspectives about their bilingual identity. Understanding how bilinguals' attitudes shape their cognitive experiences will help us to make better grouping decisions for future experiments, rather than just using "Spanish-English bilinguals" as a default comparison group.

Author e-mail: lgetz@sandiego.edu

Back to Schedule

Poster Abstracts

APCAM Sponsor Poster (1)

1 The future of research is online: Empowering behavioral research with FindingFive

Noah Nelson*	FindingFive
Ting Qian	FindingFive

Scientific research employing behavioral measures has increasingly turned to the web for data collection. This trend was accelerated by the COVID-19 pandemic, but has its roots in the replication crisis and a turn away from WEIRD (Western Educated Industrial Rich Democratic) participant pools at on-site academic institutions. However, there are numerous barriers to online research, including the technical infrastructure, know-how, and programming challenges that many researchers face.

Author e-mail: noah.nelson@findingfive.com

Back to Poster Session

2 Listening effort across multilingual languages: Interplay with cognitive ability and proficiency

Dana Bsharat-Maalouf* University of Haifa
Tamar Degani University of Haifa
Hanin Karawani University of Haifa

In challenging listening conditions, such as background noise, speech perception is more difficult, especially for multilingual listeners. In the current study, 46 Hebrew (L1)-English (L2) bilinguals and 46 Arabic (L1)-Hebrew (L2)-English (L3) multilinguals completed a speech perception task. Specifically, during the perceptual task, participants were presented with Hebrew and English single words and sentences in quiet and noisy conditions (0 dB signal-to-noise ratio), with a total of 240 stimuli per participant. After each stimulus, participants were required to repeat the stimulus they had heard, and their perceptual accuracy was recorded. Critically, during the perceptual task, participants concurrently rated their subjective sense of listening effort on a scale of 0 (minimal) to 100 (significant). Participants' working memory span and language proficiency (using self-report measures, an objective semantic fluency test, and a picture naming test) were assessed, to examine modulations of perceived listening effort.

The findings showed lower perceptual performance in the noise condition relative to the quiet condition, especially when processing the non-dominant English language. In addition, increased listening effort, indexed by higher subjective ratings, was reported for noisy conditions, especially in English. Notably, even in the quiet condition, where perception was preserved, greater effort was reported for the less dominant English stimuli compared to Hebrew stimuli, suggesting that listening effort may reveal challenges in speech processing that are not apparent through perceptual performance alone. Individual difference analysis further revealed that lower working memory and lower language proficiency were associated with higher subjective effort ratings. Additionally, these effects appeared to be influenced by language dominance and listening conditions, highlighting the importance of examining linguistic and nonlinguistic individual differences in multilingual language processing and perceived effort.

Acronyms- L1: First Language, L2: Second Language, L3: Third Language

Author e-mail: Danabsharat5@gmail.com

Back to Poster Session

3 The role of valence and speaker identity in false hearing

Ummi K. Coats*	Union College
Hannah Soliman	Duke University
Chad S. Rogers	Union College

Much prior work in speech perception has examined how multiple sources of qualitatively different information such as acoustics, lip reading, semantic context, and listener expectations are combined to achieve speech understanding. When redundant, these sources aid speech understanding (e.g., Nittroueur & Boothroyd, 1988). When in conflict, these sources can lead to false hearing. Rogers (2017) found that merely priming a semantic associate (e.g., ROW) prior to a word in noise (e.g., GOAT), led participants to falsely hearing a word predicted by the prime (e.g., BOAT). In the current work, we examine whether a different form of listener expectations can lead to false hearing: social ingroup/outgroup membership. When listening to members of one's social outgroup, one may interpret their utterances as more negative than if they were members of their ingroup.

We developed a priming paradigm similar to Rogers (2017) where listeners watched videos of speakers uttering single target words that were masked by noise. Targets were positive (e.g., MOM) or negative (e.g., BOMB) on emotional valence and were preceded by words that primed the positive (e.g., DAD) or negative (e.g., ATOMIC) target. Speakers wore a KF-94 PPE-type mask or a Niqab, a veil worn by some Muslim women. To assess whether listeners would view the Niqab speaker as an outgroup member, we administered the National Islamophobia Index (Mogahed, Chouhoud, & Buageila, 2018). When given a prime word that predicted a negative target (e.g., ATOMIC), we expected that, relative to the KF-94 speaker, listeners scoring high on Islamophobia would be more likely to falsely hear negative words consistent with the prime (e.g., BOMB), even when a positive word was presented (e.g., MOM). Discovery of such a bias could expand notions of semantic context to include social cognitive variables, and potentially indicate speech perception as an indirect measure of attitudes toward outgroups.

Author e-mail: coatsu@union.edu

Back to Poster Session

4 The effects of background noise on aperiodic neural activity during speech perception

Sarah J. Woods*	University of Utah
Jack Silcox	University of Utah
Brennan Payne	University of Utah

Listening effort (LE), the allocation of cognitive and neural resources to overcome demands during listening, is critical to understanding speech perception in acoustically challenging environments. Several prior studies have proposed non-invasive physiological markers of LE in speech perception. For example, EEG alpha power has emerged as a potential neural measure of LE. However, the magnitude and direction of the relationship between acoustic challenge and alpha power has been inconsistent in the literature. In the current study, we examine the broadband 1/f slope of the EEG power spectrum as a measure of aperiodic (i.e., non-oscillatory) neural activity during effortful speech perception. Broadband 1/f activity, which reflects irregular and aperiodic neural activity, was previously considered to reflect background noise in the EEG signal to be controlled. However, recent work has shown that this aperiodic activity varies across the lifespan, predicts individual differences in cognitive functioning, and is sensitive to task difficulty, suggesting that it may be a useful tool in characterizing LE. In the current study, we report a secondary data analysis from Silcox and Payne (2021), in which 44 normal-hearing participants aged 18-34 listened to sentences in quiet (no background noise) or in the presence of background noise (+3 dB SNR speech shaped noise). EEG was continuously recorded during listening and the broadband (2-40 Hz) EEG power spectrum was computed for each participant for quiet and noise trials separately. Using the FOOOF (fitting oscillations and one-over-f) algorithm, we decomposed the power spectrum into both aperiodic and periodic components and found that aperiodic activity was sensitive to background noise during speech perception. We discuss the implications of these results with regards to the LE literature and future investigations of speech research that may incorporate 1/f as a measure of LE.

Author e-mail: sarah.woods@psych.utah.edu

Back to Poster Session

5 Selective attending to human voices: Evidence from detections and pupillary responses

Merve Akça*	University of Oslo
Laura Bishop	University of Oslo
Jonna Katariina Vuoskoski	University of Oslo
Bruno Laeng	University of Oslo

When people attend to a target in a rapidly presented sequence of stimuli, human attentional mechanisms appear to temporarily fail. This phenomenon is called the 'attentional blink' (Raymond et al., 1992). Previous research has introduced pupillometry as a useful marker of temporal selective attention in the visual attentional blink paradigm (e.g., Zylberberg, Oliva, and Sigman, 2012; Wierda, van Rijn, Taatgen, and Martens, 2012). This is the first study investigating the attentional blink phenomenon using pupillometry in the auditory modality. In an experiment with 56 participants, we tested the intensity of cognitive processing (as measured via pupillary dilations) associated with selectively attending to auditory targets in the attentional blink paradigm. The results show that human voice targets escape the auditory attentional blink effect, and therefore may be able to overcome the temporal limits of processing and selectively attending to auditory information. Our findings also indicate that the auditory attentional blink (or lack thereof) can be effectively traced through participants' pupil dilations.

Author e-mail: merve.akca@psykologi.uio.no

Back to Poster Session

6 Listening effort exerted in eateries

Mahnoor Javed*	Toronto Metropolitan University
Hannah Shatzer	Metropolitan State University of Denver
Joseph Rovetti	University of Western Ontario
Frank Russo	Toronto Metropolitan University

Restaurants and other eateries often have high levels of background noise, forcing people to exert more effort when listening. The Lombard Effect is a tendency for individuals to involuntarily increase vocal effort when speaking in a high noise environment. Surprisingly, very little research has objectively measured the effort that people exert while listening in eateries, and no prior study has accounted for the compensatory effects afforded by the Lombard effect. The current study will address these gaps in the literature. Twenty-five adults will complete a speech perception task in which they listen to speech in noise and report the final word. There will be two independent variables manipulated in a 3 × 2 factorial design: Noise Environments (the eatery from which the noise was recorded; coffee shop, restaurant, or food court) and Speech Type (normal or Lombard). Noise will always be played at approximately the same level as the original noise recording of the eatery from which it came. In contrast, the level of the speech will be varied; when the Speech Type is normal, speech will be presented at 69 dBA; and when the Speech Type is Lombard, it will be presented louder than 69 dBA, with the precise level determined by an equation that models the Lombard effect. Concurrently, functional near infrared spectroscopy will be used to measure the oxygenation in the prefrontal cortex (PFC), an objective index of listening effort. It is hypothesized that listening effort as assessed by accuracy, self-report and PFC oxygenation will be greater in “noisy” eateries compared to “quiet eateries. It is also hypothesized that as SNR increases, listening effort will decrease, and thus, it is expected that there will be a decrease in listening effort in the presence of the Lombard Effect due to increase in SNR associated with louder speaking.

Author e-mail: mahnoor.javed@torontomu.ca

Back to Poster Session

Music (7-10)

7 Masculine and androgynous dress as a coping mechanism for non-male populations in jazz performance

Anna Fortuna* Berklee College of Music
Erica R. Knowles Berklee College of Music

International research has long established that women and gender-nonconforming individuals face challenges in jazz due to gendered perceptions and constraints (Kirschbaum, 2017). Concepts of masculinity, in particular, have shaped jazz music-making environments that can be hostile for women (Wehr-Flowers, 2006; Caudwell, 2012; Denson, 2014), reinforcing the view that jazz and improvised music is both male-defined and male-dominated (Jovicevic, 2021). In the classical realm, dress and appearance have been shown to affect perceptions of talent and skill, (Griffith, 2008), but similar studies examining presentation in jazz are virtually non-existent. Dress is of particular psychological significance for women (and gender non-conforming individuals) who have a less rigid dress code to follow than men (Bartky, 1990). I hypothesized that jazz musicians who identify as women or non-binary will choose to dress androgynously or masculinely, even if that is not their preferred way of presenting, to gain more respect from other musicians in a jazz environment. Non-identifying survey responses were collected from 75 jazz performers identifying as man, woman, and non-binary. Questions on the survey considered gender identity, gender presentation, and perceived respect tied to gender presentation. Participants felt that their gender presentation affected the perception of their playing and their professional opportunities. Women and non-binary identifying participants reported that they felt they received less respect when dressing femininely and, as a result, in jazz performance and rehearsal contexts, would choose to dress androgynously or masculinely in order to gain better treatment from men. Defining the unique problems and stressors that masculine jazz environments create for women and non-binary individuals and the coping mechanisms these populations adopt to mitigate them will enable the jazz community to understand these issues more clearly. These findings suggest more inclusive and clear dress codes as a start for potential remedies.

Author e-mail: akuser@berklee.edu

Back to Poster Session

8 The long-term stability of the speech-to-song illusion and the effects of individual differences

Rodica R. Constantine* University of Nevada, Las Vegas
Erin E. Hannon University of Nevada, Las Vegas

In the Speech-to-Song (STS) illusion, multiple repetitions of a natural spoken utterance can give rise to a perceptual switch wherein the stimulus begins to sound like song to the listener. Anecdotally, once a speech excerpt transforms to song, listeners report they experience it as song when they reencounter it even after long delays, suggesting the STS illusion is temporally stable. However, to our knowledge, the long-term stability of the STS illusion has not yet been empirically validated.

In our study, we measured the STS illusion by presenting listeners with excerpts known to elicit the STS illusion and asking them to rate the degree to which each repetition sounded song-like across delays from 0-56 days. Additionally, to assess the effect of individual differences on STS illusion elicitation and stability, we administered the Goldsmiths Musical Sophistication Index (Gold-MSI), a speech prosody test (PEPS-C), and a tonal enculturation test (from Corrigall & Trainor, 2015).

Our results empirically validate the claim that the STS illusion is stable, since at session 2, stimuli initially rated as “song” during session 1 were rated significantly more song-like than those initially rated as “speech,” regardless of delay condition. Cross-session correlations also show that ratings are stable at the stimulus level, with no variation by delay.

Moreover, STS illusion elicitation was positively predicted by Gold-MSI and tonality task scores; participants who scored higher on these measures provided higher overall ratings and experienced a more robust perceptual change from speech to song across trials. Additionally, STS illusion stability was positively predicted by performance on our speech prosody task and inversely predicted by Gold-MSI scores.

These findings show that individual differences in musical and linguistic ability affect the experience of the STS illusion and hold important implications for understanding auditory processing and memory.

Author e-mail: constr3@unlv.nevada.edu

Back to Poster Session

9 Listeners detect deviant beats better in musical rhythm contexts with fewer subdivision levels: An MMN and behavioral study

Julia Yu*	Stanford University
Aditi Tuli	Stanford University
Naomi Gong	Stanford University
Takako Fujioka	Stanford University

Musical rhythm perception often requires listeners to identify a beat structure from the ongoing context. Previous research suggests that fewer subdivisions in the rhythm would be easier to extract beats via sequential processing, whereas increased levels of subdivisions would require hierarchical processing.

We hypothesized that the number of subdivision levels would influence listeners' ability to detect deviant beats. This would be reflected in higher behavioral performance as well as a larger amplitude of mismatch negativity (MMN).

We recorded EEG while participants passively listened to a variety of rhythms. Each rhythm contained a prime part and subsequent steady beats, following the time signature of 2/4. The prime part was one of four conditions; (1) two quarter notes, (2) two 8th and one quarter note, (3) four 8th notes, and (4) a dotted 8th and a 16th note pattern twice repeated. The subsequent pattern was always the same regardless of primes, consisting of three quarter notes in the standard trials or the final note occurring an 8th or 16th note earlier in the deviant trials. After the EEG recording, participants also had to determine whether two presented rhythms were the same or different.

The MMN was primarily evident in the frontocentral electrodes. Deviant 8th conditions elicited a significantly larger MMN than deviant 16th conditions across all primes. Behaviorally, listeners also had more difficulty detecting the smaller temporal deviation of 16th compared to the 8th. However, when primes contained more subdivisions, behavioral accuracy significantly decreased, indicated by a Prime x Deviant interaction. These results support our hypothesis that the subdivision level of rhythm affects one's ability to extract beats. Our findings further point to the interplay between sequential and hierarchical processing in extracting beat structure in auditory rhythms.

Author e-mail: juliasyu@stanford.edu

Back to Poster Session

10 Influence of spectral envelopes on the pitch of Shepard tones

Laura Reinert	James Madison University
Michael D. Hall*	James Madison University

Shepard tones (containing several octaves of the same musical chroma; e.g., Shepard, 1964) are assumed to reflect ambiguous pitch. Yet, the direction of pitch change is perceived consistently within listeners in the tritone paradox (e.g., Deutsch, 1986), where two Shepard tones are sequentially presented with chroma differing by a half-octave. Psychoacoustic accounts include general influences of shifts in spectral centroid/envelope (Repp, 1997) and individual differences in the perceptual prominence of lower frequencies, such as the fundamental/F0 (Malek, 2018).

The current investigation further evaluated contributions of these factors to pitch for both Shepard tones and harmonic series, plus any associated relationship between pitch performance and the amount of the listener's musical training. Tones included "slope" harmonic tones (where amplitude fell with increasing component frequencies), "peak" harmonic tones (where amplitude increased from -70 dB at F0 to maximum at the third harmonic, and gradually reduced thereafter), and Shepard tones (from Deutsch, 1986). These were generated at two centroids (C5 and F#5), and eight chroma (C3, C#3, D3, D#3, F#3, G3, G#3, and A3). Listeners completed a 2AFC discrimination task. On each trial, a standard (slope) and comparison tone (of any variety) separated by a tritone were presented; their centroids were either matched or mismatched. Listeners judged whether pitch ascended or descended. Participants self-reported amounts of musical training via questionnaire.

Sensitivity (d') varied considerably across centroids and chroma for Shepard tones, yet remained high across harmonic tones. Sensitivity increased with musical training for all tones, reflecting greater reliance on F0. Acoustic analyses revealed that performance for Shepard tones was predicted by relative F0 amplitude, with poorer/variable performance occurring when F0 was weak. These findings suggest a systematic process for making pitch judgments that applies to both harmonic and Shepard tones and that accounts for the individualized patterns of results in the tritone paradox.

Author e-mail: hallmd@jmu.edu

Back to Poster Session

Auditory Scene Analysis (11-13)

11 Perception of global properties, objects, and settings in natural auditory scenes

Margaret A. McMullin*	University of Nevada, Las Vegas
Rohit Kumar	Johns Hopkins University
Nathan C. Higgins	University of South Florida
Brian Gygi	East Bay Institute for Research and Education
Mounya Elhilali	Johns Hopkins University
Joel S. Snyder	University of Nevada, Las Vegas

Theories of auditory scene analysis suggest our perception of scenes relies on identifying and segregating objects within it, resembling a detail-oriented processing style. However, a more global process may occur while analyzing scenes, which has been evidenced in the visual domain. We evaluated the contributions of high-level global and low-level acoustic information to auditory scene perception. An additional aim was to increase the field's ecological validity by using and making available a new collection of high-quality natural auditory scenes. In our first experiment, participants rated scenes on 8 global properties (e.g., open vs. closed) and an acoustic analysis evaluated which low-level features predicted their ratings. Exploratory factor analyses revealed the global properties and acoustic variables were explained by two and seven-factor models, respectively. The acoustic variables linearly predicted the global ratings by different amounts (R-squared = 0.33-0.87), although we also observed nonlinear relationships between acoustical and global variables. In a second experiment, we evaluated participants' accuracy in identifying the setting of—and objects within—scenes across three durations (1, 2, and 4s). Overall, participants performed better on the object identification task, but this performance was contingent on a longer stimulus duration. These results suggest object identification may require more processing time and/or attention switching than setting identification. Finally, two computational models trained to perform object and setting identification were compared to global property ratings. Compared to the object-driven model, the setting-driven model exhibited higher correlations with several global properties. We also found that shorter scene durations led to noisier perceptual judgments. Our results provide insight into the mechanisms underlying natural auditory scene perception and suggest representations of auditory objects may be transformed through many stages of processing in the ventral auditory stream, paralleling previous findings on the ventral visual stream.

Author e-mail: mcmulm1@unlv.nevada.edu

Back to Poster Session

12 Auditory perception of occlusion: Impact of obstruct size

Michael K. Russell* Bellevue University

The world within which we perceive and act is often cluttered. Yet, little research has examined auditory perception in cluttered settings. As can be imagined, the extent to which clutter affects the sound reaching the ear is dependent on three factors: (1) the physical properties of the clutter, (2) the physical properties of the auditory stimulus, and (3) the spatial relationship between source, observer, and obstruct. Variations in any one of those three factors may alter the amount of sound reflected off, transmitted through, and diffracted around a barrier. Given the right conditions, a single piece of clutter can dramatically modify the sound reaching an observer's ear and, thus, observer perceptions. Russell and Brown (2019) found individuals are capable of both accurately detecting the presence of an occluding object and creating a state of occlusion. However, that study utilized an obstruct of fixed dimensions and unwavering material composition, a single auditory stimulus, and an invariant source-observer-barrier spatial relationship. The purpose of the present study was to determine the extent to which auditory occlusion detection is affected by variations in the physical dimensions of the occluding object. In brief, the height, width, and depth of the occluding object was manipulated. It was hypothesized that, overall, an increase in the size of the occluding object will result in an increase in perceptual accuracy. It was further hypothesized that perceptual accuracy will primarily be affected more at the extreme levels of occlusion (0%, 100%) than at moderate levels of occlusion (25%, 50%, 75%). Given we commonly inhabit cluttered spaces, the findings of the present study have significant implications on our understanding of how we perceive the world when relying solely on sound.

Author e-mail: mirussell@bellevue.edu

Back to Poster Session

13 Effects of acoustic and visual motion on loudness change

Maggie K. McCracken* University of Utah
D. Kevin McGee University of Utah

The human brain typically produces accurate motion perception with visual information, while auditory estimates remain anticipatory. Also referred to as the auditory looming bias, this has been exhibited through various acoustic tasks, including estimates of arrival time, speed, and loudness change. It is well established that loudness change estimation is greatest when sounds are presented without accompanying visual motion. However, It is unknown how accompanying visual motion interacts with the type of sounds, which can influence the saliency of moving sound sources. In the current study, participants completed loudness change estimations across types of sound (sinusoidal or white noise), intensity change (increasing or decreasing), and with or without coincident visual motion. The results show that loudness change ratings were highest in increasing sinusoidal sounds and lowest in visual-accompanying decreasing tonal sounds. Further, there were more significant discrepancies in loudness change for tonal sounds. These results suggest that the salience between moving sounds is partially driven by additional information. Overall, this study shows that proxies for auditory motion perception are influenced by both within-auditory factors (type of sound), between-modality factors (visual accompaniment), and redundant factors (direction of motion). These findings can be utilized in various high-information environments to reduce cognitive load during demanding tasks.

Author e-mail: maggie.mccracken@psych.utah.edu

Back to Poster Session

Cross-Modal Perception (14-15)

14 Exploring modality differences in recognition memory: Repetition effects on recollection and familiarity

Sharica Lee*	University of Nevada, Las Vegas
Kevin Mohawk	University of Nevada, Las Vegas
Margaret A. McMullin	University of Nevada, Las Vegas
Laura Werner	University of Nevada, Las Vegas
Joel S. Snyder	University of Nevada, Las Vegas
Colleen M. Parks	University of Nevada, Las Vegas

Visual recognition memory's superiority to auditory memory is well established, however, we know little about modality differences between the component processes of recognition, recollection and familiarity. In our previous work, we found that modality had larger effects on recollection than on familiarity, however that included a difference between overall recognition (da) of auditory and visual objects. When we equated overall recognition memory by presenting the auditory stimuli twice and the visual stimuli once, we still found the same differences in recollection and familiarity as we did before even though we equated overall recognition. It also appeared to us that the estimates of recollection in the auditory (2x) condition were similar to previous work when auditory objects were not repeated. To examine whether repetition does or does not affect auditory recollection, we compared two groups: auditory objects presented once or twice (with both groups seeing visual objects once). We found that repetition, while affecting overall recognition, had no measurable effect on auditory recollection, but did on auditory familiarity. Combined with prior work, which has shown little to no effect of divided attention on auditory recollection, these results suggest that auditory recollection is qualitatively different from visual recollection.

Author e-mail: lees244@unlv.nevada.edu

Back to Poster Session

15 When and why can visual stimuli increase sound pleasantness?

Laurie M. Heller*	Carnegie Mellon University
Megan Julien	Carnegie Mellon University
Urszula Oszczapinksa	Carnegie Mellon University
Jessica M. Smith	Carnegie Mellon University

We conducted 3 experiments to understand why certain visual stimuli can increase sound pleasantness. First, we created a set of movies to alter the interpretation of unpleasant sounds. Unpleasant sounds, such the sound of utensils scraping, were paired with videos of a neutral event that matched the sound's timing and timbre, such as chirping birds. We also included sounds that are typically unbearable to people with misophonia, such as the sound of chewing. In Exp. 1, participants first rated the pleasantness of the sounds. Next, participants viewed the movies and rated the sounds. We found, like Samermit et al. (2019), that sounds were significantly more pleasant during the movies. In addition, we found this held true for participants who obtained clinical misophonia scores on the DVMSQ scale. Exp. 2 was designed to disentangle the effect of causal reinterpretation from the effects of viewing something mildly pleasant while listening. Exp. 2 was identical to Exp.1 except that the visual stimuli were abstract paintings which were devoid of semantic context. Sounds were rated as significantly more pleasant when paired with paintings, but the effect size of paintings was only 32-37% as large as the effect size of movies. Therefore, approximately 2/3 of the effect in Exp. 1 is attributable to the videos altering the perceived causes of sounds. Exp. 3 showed that mere exposure to these repeated sounds did not account for the increased sound pleasantness caused by movies and paintings. [Funded by REAM].

Author e-mail: laurieheller@cmu.edu

Back to Poster Session

16 The relationship between hearing screenings and anxiety, depression, and sleep

Chris Koch* George Fox University

Several studies have shown that anxiety, depression, and insomnia often accompany tinnitus (Alster, Shemesh, Ormam, & Attias, 1993; Cronlein, Langguth, Geisler, & Hajak, 2007; Erlandsson, Hallberg, & Axelsson, 1992; Folmer and Griest, 2000; Konong, 2019; Wakabayashi, Saito, Oishi, Shinden, & Ogawa, 2018). Specifically, more severe tinnitus is associated with more sleep disruptions and greater emotional distress. Previous research has also found that hearing loss is related to anxiety, depression, and sleep (e.g., Miguel, Yaremchuk, Roth, & Peterson, 2014; Seydel, Haupt, Olze, Szczepek, & Mazurek, 2013). This study was conducted to determine if these relationships could be found with a simple hearing screening (Coren and Hakstian, 1992). The hearing screening inventory was given to 156 undergraduates along with the GAD-2, PHQ-2, and a sleep assessment. Although the results show that hearing loss was significantly correlated with higher anxiety and depression, hearing scores were unrelated to sleep. The results for anxiety and depression are consistent with the cognitive-behavioral model of tinnitus proposed by Cima et al. (2012). However, failure to find a relationship between hearing and sleep suggests that either hearing screenings are not sensitive enough for sleep disturbances or that the relationship between hearing and sleep requires a wider age range than that included in the present study.

Author e-mail: ckoch@georgefox.edu

Back to Poster Session

17 Cortical tracking of visual and auditory information in children with cochlear implants

Tatiana Matyushkina*	Center for Mind and Brain, UC Davis
Sharon Coffey-Corina	Center for Mind and Brain, UC Davis
Lee Miller	Center for Mind and Brain, UC Davis
David Corina	Center for Mind and Brain, UC Davis

In congenitally deaf individuals, auditory cortical regions might be recruited by non-auditory functions as a result of neuroplasticity. In case of delayed cochlear implantation this might lead to functional disintegration between auditory areas and pose challenges to development of speech perception. Of particular interest is to see how the presence of visual stimulation affects speech percepts in young CI users in comparison to typically hearing children. We are using predictive modeling (mTRF toolbox by Crosse et al. (2015)) to quantify the relationship between features of speech and visual stream and the EEG signal. In the study the participants were instructed to watch a silent cartoon presented in the middle on the screen while two concentric checkered rings in the background were flickering at different frequencies (7.5 and 12 Hz) and ambient speech stream unrelated to the cartoon was playing). Periods of ambient speech occurred in the presence and absence of the visual flicker stimulation.

We analyze how speech stream features such as envelope, as well as visual stream features such as flickers are tracked in children with CI and typically hearing children in this setting. The analysis has revealed that the hearing group shows enhanced envelope tracking in central frontal channels when compared to CI group. It also shows that adding visual stimuli as a regressor to the model for the hearing group does not improve the model fit. However, in the CI group there is more variability between subjects with some showing significant enhancement of audio-visual model fit. In the posterior regions there was a main effect of the model, with the audio-visual model showing higher correlation scores compared to the envelope model for both groups.

Author e-mail: tmatyushkina@ucdavis.edu

Back to Poster Session