APCAM 2013

12th Annual Auditory Perception, Cognition, and Action Meeting

Thursday, November 14th

Sheraton Centre Toronto Hotel

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Program sponsored by

WASHBURN UNIVERSITY

Welcome to APCAM 2013

APCAM was established " to bring together researchers from various theoretical perspectives to present focused research on auditory cognition, perception, and aurally guided action." Now in its twelfth year, APCAM remains true to this mission. It represents one of the few meetings where mixed within the same session you can find a mixture of auditory researchers doing basic and applied work, exploring constructive and direct perception models, testing low-level and high-level accounts, as well as evaluating the processing of speech, music, and environmental noises.

If you have previously been involved in conference planning, then you know that it takes the support of several groups of people to make a meeting successful. This year's APCAM is no exception, and we are grateful to everyone who helped plan this event. We would particularly like to thank the Psychonomic Society, which continues to cover all room and equipment fees for this meeting. A special thanks also is in order for Washburn University, which for years has assumed all costs and responsibilities for the creation and printing of the conference program. These important contributions have enabled this year's meeting to again be offered free of charge to all attendees. This is an unusual benefit, and one that seems fitting given APCAM's distinctive mission (i.e., to provide a forum for different perspectives).

Ultimately, perhaps the biggest debt is owed to APCAM attendees and presenters. This includes the many regular attendees over the years who have helped to make this a welcoming and diverse scientific forum, as well as to the many newcomers who further enrich the program's content and resulting discussion. We hope that, regardless of whether you are a regular or a newcomer, you will enjoy your meeting experience and continue to include APCAM in your conference circuit in the future. If so, then please invite colleagues to join us so that this meeting can continue to grow. For now, know that your contributions have helped to create what we believe to be a very strong program for this year's meeting. Have a pleasant and productive day at APCAM 2013.

Sincerely,
The APCAM 2013 Organizing Committee
Michael D. Hall (Chair)
Devin McAuley
John Neuhoff (Founder)
Kristopher Patten
Peter Q. Pfordresher
Mike Russell

APCAM 2013 Schedule		
8:00	**Registration – Dominion Ballroom South (2nd floor)**	
8:30	**Opening Remarks**	
	General (abstracts pages 8 – 9)	
8:40	Slow Change Deafness	**John Neuhoff* Aurielle Baker-Coleman Breanna Bertacchi Catherine Benton Ann Berkow Connor Brown Gabriel Joseph Mamoudou N'Diaye Joe Wayand**
9:00	Individual differences in auditory spectral temporal order judgments (TOJ)	**Leah Fostick* Harvey Babkoff**
9:20	Perceptual load does not determine auditory distractor processing	**Sandra Murphy* Nick Fraenkel Polly Dalton**
9:40	Perception of Octave Equivalence is Highly Context Dependent	**Ronald Weisman* John Hoang Marisa Hoeschele Allison H. Hahn Christopher Sturdy**
10:00	**Break (20 mins)**	
	Music (abstracts pages 10 – 11)	
10:20	The Influence of Tonality on Sight-Reading Accuracy	**Olivia Podolak* Mark A. Schmuckler**
10:40	Mental Transformations of Auditory Imagery During Vocal Imitation	**Emma Greenspon* Peter Pfordresher Andrea Halpern**
11:00	Probing Modulations in South Indian Classical Music by Indian and Western Musicians	**Rachna Raman* W. Jay Dowling**

11:20	The Perception of Trombonist Movement through Musical Sound	**Alexander P. Demos* Roger Chaffin**
Poster Session (11:50 AM – 1:10 PM) Osgoode Ballroom and Sheraton Hall (located on the lower concourse) Abstracts located on pages 16 – 29		
Lunch (1:10 – 2:00 PM)		
Invited Address (abstract page 12)		
2:00	***Does listening difficulty alter the degree to which bottom-up (stimulus driven) and top-down (knowledge-based) processes contribute to speech comprehension?***	***Bruce A. Schneider***
Speech (abstracts page 13)		
2:40	Contributions of the vocal source to vowel perception	**Ashley A. Assgari* Michael D. Hall**
3:00	Function word perception depends on (a) speech cue(s) several syllables downstream	**Meredith Brown* Laura C. Dilley Michael K. Tanenhaus**
3:20	**Break (20 min)**	
Speech (abstracts pages 14 – 15)		
3:40	Convergence in speech rate in scripted dialogues: Confederate influences the speech rate of naive participants	**Benjamin G. Schultz* Irena O'Brien Natalie Phillips David McFarland Debra Titone Caroline Palmer**
4:00	Her voice lingers on and her memory is strategic: Effects of gender on directed forgetting	**Hwajin Yang * Sujin Yang Giho Park**
Panel Discussion (abstract page 15)		
4:20	Recent Trends in (the Pursuit and Publication of) General Auditory Perception Research	**Michael D. Hall* John Neuhoff* Peter Pfordresher***
5:00	**Closing Remarks**	

Posters (abstracts located on pages 16 – 29)		
1	**Exploring the Attentional Demands of Whispered Speech**	**Anne Pier Salverda Meredith Brown Jennifer Roche***
2	**Music exposure and acute stress recovery among young adults**	**Gabriela Ilie***
3	**High and low working memory capacity individuals are equally distracted by surprise**	**Patrik Sörqvist***
4	**School Acoustics: A Decisive Factor in the Learning Process**	**Robert Ljung***
5	**Temporal control of discrete and continuous movements in cello playing: The role of working memory**	**Pieter-Jan Maes* Caroline Palmer Marcelo Wanderley**
6	**Psychophysiological Responses to Auditory Change: An Investigation of Pitch, Timbre, Tempo, Loudness and Duration Changes on Autonomic and Facial Motor Responses**	**Lorraine Chuen* David Sears Stephen McAdams**
7	**Tricking the Ear: Using a Quadri-stable Auditory Illusion to Influence Sound Localization**	**Constance May Bainbridge* Wilma Alice Bainbridge Aude Oliva**
8	**The consequence of harmonic enhancement on the perception of concurrent auditory objects in a complex sound**	**Brandi Lee Drisdelle* Pierre Jolicoeur**
9	**Familiar, but I don't know about preference: Acquisition and generalization of modal pitch distributions.**	**Anja-Xiaoxing Cui* Meghan Collett Niko Troje Lola Cuddy**
10	**An Investigation of the Perceptual Experience of Syncopation**	**Laura Getz* Scott Barton Michael Kubovy**
11	**Beta- and gamma-band electroencephalographic activity indicates pulse in non-isochronous syncopated rhythms**	**Gabe Nespoli* Paolo Ammirante Frank Russo**
12	**Attentional capture by sound disappearance.**	**Nicholaus P. Brosowsky* Todd A. Mondor**

13	**Auditory-vocal crosstalk at the sequence-level: Evidence from the order incongruence effect in serial recall**	**John Marsh* Paul Taylor Jeannie Judge Robert Hughes**
14	**Communicating Emotion in Music: The Role of Mode, Pitch and Timing Cues**	**Diana Martinez* Raven Hebert–Lee Michael Schutz**
15	**Auditory versus visual perception of gap size at the microscale level**	**Skyler Gentry* Michael K. Russell**
16	**Time-to-Arrival Detection within Virtual Acoustic Environments**	**Daniel Kobylarz* Michael S. Gordon Darlene Edewaard**
17	**Will it hit me or will I hit it? Perception of collision as a function of motion and modality**	**Delanie Atteberry* Michael K. Russell**
18	**An evaluation of the role of vowel formant frequencies on the perception of foreign accent**	**Kit Ying Chan* Michael D. Hall Ashley Assgari**
19	**Change Deafness: Gradual Versus Abrupt Changes in Pitch of Human Voices**	**Melissa Folan Jordan Manley Erin Naumann Joseph Wayand***
20	**Perceptual error is not an error: A Gibsonian, ecological interpretation of slippage**	**Michael K. Russell**
21	**Falling Stars: Acoustic Influences on Meteor Detection**	**Darlene E. Edewaard* Michael S. Gordon Mohamed G. Ismail**
22	**Ability to synchronize to music predicts ability to synchronize with another person**	**Roger Chaffin* Alexander P. Demos Katherine Alfred Kerry L. Marsh**

23	**Skull Music: Influences of Head Resonant Frequencies on Musical Preferences**	**Jitwipar Suwangbutra Michael S. Gordon* Alejandro Ataucusi**
24	**Perception and Structure in Jazz Rhythm: Is Hearing Always Believing?**	**Brian C. Wesolowski***
25	**Hearing Research: Are we evaluating what we hear?**	**Jessica Gillard* Michael Schutz**
26	**An Audio Feature Analysis of the Toronto Emotional Speech Set (TESS)**	**Naresh N. Vempala* Frank A. Russo**
27	**Motor simulation while judging sung melodic intervals**	**Frank A. Russo* Paolo Ammirante***

Oral Presentations

8:40

Slow Change Deafness

John Neuhoff* *The College of Wooster*
Aurielle Baker-Coleman *The College of Wooster*
Breanna Bertacchi *The College of Wooster*
Catherine Benton *The College of Wooster*
Ann Berkow *The College of Wooster*
Connor Brown *The College of Wooster*
Gabriel Joseph *The College of Wooster*
Mamoudou N'Diaye *The College of Wooster*
Joe Wayand* *Walsh University*

Change blindness and change deafness experiments typically present abrupt, above threshold stimulus changes that go unnoticed by a large portion of observers. Some work in vision also shows that large but slow changes in a visual scene can also go completely unnoticed over time. Here we examined whether a similar phenomenon "slow change deafness" occurs in the auditory domain. We presented listeners with a two-minute speech stream read from a novel by either a male or female speaker. We slowly altered vocal pitch up or down three semitones over the course of the clip (without affecting the rate of speech). Participants monitored the speech signal while performing either an "easy" (counting color words) or a "hard" (counting the speaker's breaths) task and then answered standard change deafness questions following the stimulus presentation. Across all conditions 49% of our participants failed to notice the change. Change in female speakers was detected at a marginally higher rate than male speakers, and increases in vocal pitch were detected more often than decreases. There was no effect of distractor task difficulty. The results will be discussed in terms of auditory attention to the indexical characteristics of the speaker versus the semantics of the speaker's message.

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9:00

Individual differences in auditory spectral temporal order judgments (TOJ)

Leah Fostick* *Ariel University Center, Ariel, Israel*
Harvey Babkoff *Ashkelon Academic College, Ashkelon, Israel*

Auditory spectral TOJ thresholds measure the ability to perceive the order of two tones of different frequency in a pair. In a series of studies carried out on 461 different participants, we found that 50% of participants had very low thresholds (< 5 msec); 23% had thresholds ranging from 5-120 msec; and 27% had very high thresholds (> 120 msec). In an attempt to define what parameters affect this response pattern, we focused in the current study on five types of variables: (1) methodology and stimulus characteristics; (2) group differences; (3) participants' cognitive ability; (4) auditory processing; and (5) linguistic characteristics. The frequencies of the tones affected the pattern of threshold distributions. There was a significantly higher prevalence of low thresholds when the stimuli were low frequency tones (300 and 600 Hz) and a significantly higher prevalence of 5-120 msec thresholds when the tones were 1 kHz and 3.5 kHz. Methodology, absolute threshold, or performance on other temporal resolution tasks had no effect on the pattern of threshold distributions. Participants with very high spectral TOJ thresholds (> 120msec) had significantly poorer scores on the matrices task and on the phonological awareness task. However, speech perception, auditory and spatial memory, attention, and bilingualism did not differentiate between spectral TOJ threshold groups. These preliminary results strengthen the argument that the determination of spectral TOJ thresholds may be accomplished by several perceptual mechanisms, of which temporal resolution may be but one. Stimulus parameters, e.g., the frequencies and differences in frequency between the tone pairs as well as cognitive-speech parameters of the listener are relevant in determining spectral TOJ thresholds.

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9:20

Perceptual load does not determine auditory distractor processing

Sandra Murphy* *Royal Holloway, University of London*
Nick Fraenkel *Royal Holloway, University of London*
Polly Dalton *Royal Holloway, University of London*

Perceptual load theory suggests that the perceptual demands of the relevant task determine whether distracting stimuli can successfully be ignored (Lavie, 1995). While the theory has received a vast amount of support in vision (see Lavie, 2010, for a recent review), much less research has addressed whether the same principles hold within the auditory domain. Four experiments examined this issue, using two different manipulations of perceptual load. In two experiments, distractor processing was measured through response competition in an auditory flanker task, while in the other two experiments awareness report of a critical stimulus was measured in an inattentional deafness paradigm. Across all experiments, we failed to find any effect of perceptual load. Despite successful load manipulations, distractor processing did not reduce with increased perceptual demands. We therefore propose that the auditory system is more likely than the visual system to retain spare processing capacity, which means that irrelevant auditory distractors are likely to receive some processing regardless of the perceptual load in the attended stream. This suggestion accords well with the 'early-warning' function of the auditory system, allowing for detection of changes occurring in the auditory scene even when the perceptual demands of the relevant task are high. Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. Journal of Experimental Psychology: Human Perception and Performance, 21, 451–468. Lavie, N. (2010). Attention, distraction, and cognitive control under load. Current Directions in Psychological Science, 19(3), 143-148.

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9:40

Perception of Octave Equivalence is Highly Context Dependent

Ronald Weisman* *Queen's University, Kingston, Ontario*
John Hoang *University of Alberta, Edmonton, Alberta*
Marisa Hoeschele *University of Vienna, Vienna, Austria*
Allison H. Hahn *University of Alberta, Edmonton, Alberta*
Christopher Sturdy *University of Alberta, Edmonton, Alberta*

Octave equivalence occurs when notes separated by an octave are judged perceptually similar. Considerable evidence points to the importance of the octave in music and speech. Using go/no-go operant discrimination, generalization, and transfer tasks, we studied octave equivalence in humans. We contrasted two highly similar discrimination-training conditions: in both groups, the 12 musical notes that comprise Octave 4 were divided into go and no-go note ranges and both groups heard 6 go notes and 6 no-go notes. The octave-centered discrimination divided Octave 4 into three ranges 3 no-go notes, 6 go notes, then 3 no-go notes. Octave non-centered discrimination 1 divided Octave 4 into two ranges: 6 go notes then 6 no-go notes; octave non-centered discrimination 2 inverted the order: 6 no-go notes then 6 go notes. Notes in each range were contiguous in pitch and aligned with the 12 notes in the chromatic scale but were presented repeatedly in random order without replacement throughout the experiment. During subsequent generalization and transfer tests, the centered discrimination group perceived octave equivalence during generalization and transfer of the discrimination to Octave 5 but not to Octave 6. Neither non-centered discrimination group 1 nor group 2 showed evidence of octave equivalence in either Octave 5 or 6, instead both groups gave evidence only of pitch height perception. Given the similarities between the protocols of the centered and non-centered discriminations, the differences we observed between the groups in the generalization and transfer tests were surprising. In summary, our results suggest that octave equivalence (i) survives the presentation of notes in random order without a consistent melody or pattern, (ii) equivalence is context dependent, that is, the task provides the necessary context, (iii) equivalence may be limited over multiple octaves by interference from perception of pitch height and of higher harmonics.

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10:20

The Influence of Tonality on Sight-Reading Accuracy

Olivia Podolak* *University of Toronto Scarborough*
Mark A. Schmuckler *University of Toronto Scarborough*

Tonality is a concept that has been, and continues to be thoroughly researched within music-theoretic and psychological domains of research; however, it is rarely the focus of music performance studies. Thus, the present study sought to investigate how knowledge of the tonal hierarchy in used in sight-reading by comparing sight-reading accuracy across three tonal constructs: major, minor and atonal. It was hypothesized that sight-reading performance should be the worst in instances with no tonal information, as participants would be unable to generate appropriate expectancies to guide their sight-reading. To test this, twelve experienced pianists sight-read major, minor and atonal versions of monophonic, homophonic and polyphonic excerpts. The results indicated that pianists performed the major excerpts with greater accuracy than the atonal excerpts. Furthermore, the errors made within the major excerpts were significantly biased towards diatonicism, providing a clear demonstration of how pianists' expectations might have contributed to their sight-reading performance. This bias was not found in the minor excerpts, possibly suggesting that the minor hierarchy does exert as much of an influence during sight-reading. Lastly, there were no global shifts towards tonality in participants' atonal performances, necessitating investigations into local shifts of tonality instead. Future directions include investigations into the influence of rhythmic and metrical structures of music on sight-reading, and applications of mobile eye-tracking technology to the present paradigm.

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10:40

Mental Transformations of Auditory Imagery During Vocal Imitation

Emma Greenspon* *University at Buffalo*
Peter Pfordresher *University at Buffalo*
Andrea Halpern *Bucknell University*

We tested the hypothesis that individuals exhibiting a vocal pitch imitation deficit (VPID) are deficient in generating auditory mental images of pitch. Auditory imagery has been linked to motor planning areas in the brain and may serve a crucial role in the translation between perceptual and action-based information (Leaver, Van Lare, Zielinski, Halpern, & Rauschecker, 2009; Zatorre, Halpern, & Bouffard, 2010). A previous study demonstrated that self-reports of the vividness of auditory imagery were lower among VPID individuals than accurate vocal imitators (Pfordresher & Halpern, 2013). Here, we gave auditory imagery tasks in which people had to produce or recognize different transformations of a target melody. Target melodies were 3 or 4 note melodies produced using synthetic male and female timbres in the key of C. The transformations included singing the melody in a new key, singing the melody starting from a new serial position and singing the melody in reverse order. A corresponding task tested participants' ability to recognize transformations of target melodies. We found that VPID singers were on average unable to accomplish the transformation tasks, while accurate singers could. This was seen in both the recognition and production data. Furthermore, VPID singers accurately assessed themselves as being deficient in auditory imagery as measured by the Bucknell Auditory Imagery Scale (Pfordresher & Halpern, 2013).

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11:00

Probing Modulations in South Indian Classical Music by Indian and Western Musicians

Rachna Raman* *The University of Texas at Dallas*
W. Jay Dowling *The University of Texas at Dallas*

A fundamental purpose of this dissertation was to test whether theories and principles of music cognition and perception derived using western music can be applied to other styles of music, in this case, South Indian classical (Carnātic) music. Previous investigations showed that listeners use culture-specific and low-level sensory cues to comprehend familiar music whereas they relied mainly on sensory cues and schematic knowledge gained from listening to music of their own culture to understand unfamiliar music. Research also shows that listeners hold mental representations of the hierarchical ordering of notes in musical scales of one's culture which they readily access when listening to familiar and unfamiliar melodies. The existence of such representations has been demonstrated in real time using behavioral and neuroimaging techniques. The goals of the present study were to 1) behaviorally track listeners' responses to two types of modulation as they developed over time in Carnātic music and 2) identify the various cues that listeners, familiar and unfamiliar with the music, utilized in order to perceive the modulations. The purpose of Experiment 1 was to obtain baseline profiles of four rāgams (modes) and compare these against profiles of modulating excerpts containing the same rāgams in Experiment 2. Carnātic and western music teachers heard brief Carnātic excerpts in one ear while in the other ear they heard a continuously sounded probe-tone. The probe-tone was one of the twelve chromatic notes of an octave. Participants judged continuously how well the probe-tone fitted with the melody. Results showed that western teachers' responses matched those of the Indians on rāgams that had structures similar to the western scales but differed considerably when the rāgams were unfamiliar. Also, there were differences in the two groups' responses to modulations. These discrepancies were primarily due to the influence of culture. The findings supported previous research and identified three types of cues: 1) culture-specific cues, which included theoretical knowledge of the rāgams and familiarity with the excerpts in the study, employed by Indian teachers, 2) basic psychophysical cues of duration and frequency of note occurrence employed by both Indian and western participants, and 3) transference of schematic knowledge of western music by western participants.

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11:20

The Perception of Trombonist Movement through Musical Sound

Alexander P. Demos* *Department of Psychology, McGill University*
Roger Chaffin *Department of Psychology, University of Connecticut*

Sound-producing movements create the musical sounds of a performance. Performers' postural sway is often regarded as ancillary. This makes it difficult to explain results showing that sway is related to musical structure and expression. To explain the relationship, we take a dynamical systems approach, viewing the different types of movement as synergistically linked to each other, and to the musical structure and the performers' expressive intentions. On this view, performers' movements should be complexly, but systematically, related to musical structure and listeners should be able to hear both the metaphorical motion implied by the musical structure and the real movements performers. We tested these predictions in three experiments using statistical tools for analyzing dynamical systems to examine force plate measurements of postural sway. In Experiment 1, two trombonists played two solo pieces with different musical structures in different expressive styles (normal, expressive, non-expressive). In Experiment 2, participants listened to the performances recorded in Experiment 1 while "conducting" them. In Experiment 3, the same two performers played along with their own and the other musician's performances, mirroring the expression. In Experiment 1, performers' movements were related to musical structure in complex ways that depended on the musical context created by the interaction of piece, performer, and expressive style. In Experiments 2 and 3, listeners and performers mirrored both the real movements of the performer they listened to and the metaphorical motion implied by the musical structure. In other words, musical sound conveyed information about movement. Our results suggest that sound producing movements, ancillary movements, and the performer's interpretation of the musical structure and expressive intentions are all synergistically linked with each other in a complex dynamical system.

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2:00

Invited Address

Does listening difficulty alter the degree to which bottom-up (stimulus driven) and top-down (knowledge-based) processes contribute to speech comprehension?

Bruce A. Schneider *University of Toronto Mississauga*

To comprehend speech, not only do listeners have to hear the individual words and phrases spoken by each person in the noisy situations characteristic of everyday life, they also have to integrate this information with past input and world knowledge in order to extract each person's meaning and point of view. Hence, spoken language comprehension requires the smooth and rapid functioning of an integrated system of perceptual and cognitive processes. In a recent series of studies we manipulated the difficulty of the listening situation by varying the number of talkers, the degree of spatial separation among the talkers, the timbre of their voices (diffuse versus compact) and the signal-to-noise ratio of the talker to a babble background. We found that the degree to which individual differences in top-down lexical knowledge (as measured by the Mill Hill vocabulary test) accounted for individual differences in comprehension (the number of questions answered after overhearing a conversation) varied with listening difficulty. When the SNR is favorable and scene analysis is easy, it appears that lexical access depends primarily on bottom-up processes, with the result that individual differences in the extent of a person's vocabulary contribute little to comprehension. Conversely, when the listening situation becomes more difficult, individual differences in vocabulary are more highly correlated with the degree to which the listeners are able to comprehend the material. It appears that when the listening situation is easy, bottom-up, stimulus-driven processes are primarily responsible for gaining access to the meaning of words. However, when the listening situation becomes difficult, and the results of bottom-up lexical processes become suspect, greater weight is given to top-down knowledge-driven lexical processes. Interestingly, the degree to which individual differences in higher-order non-auditory cognitive processes (such as those measured by the Nelson-Denny reading comprehension test) contribute speech comprehension appears to depend on the characteristics of the listeners (younger native listeners, older native listeners, young non-native listeners). The implication of these findings for models of attentional-resource allocation will be discussed.

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2:40

Contributions of the vocal source to vowel perception

Ashley A. Assgari* *James Madison University*
Michael D. Hall *James Madison University*

Relatively few studies have investigated contributions by the vocal source on phoneme perception (rather than filtering by the vocal tract). One study (Ryalls & Lieberman, 1982) argued that vowel perception decreases with increases in fundamental frequency (F0) due to poorer sampling of the spectral envelope shape. The current investigation consisted of three vowel categorization experiments derived from earlier work in our laboratory (Becker, 2012) that explored influences of source characteristics on the perception of two adjacent vowel categories, specifically, whether listeners perceptually rely on formant center frequencies rather than the envelope shape. The primary manipulation was mistuning of harmonics closest to F1 and F2 peaks (0, 15, 30 Mels). In Experiments 1 and 2 mistuning was orthogonally manipulated with F0 (220, 252, 285 Hz) and amount of noise (Exp.1:0-15 noise-to-harmonic ratio; Exp.2: 0, 3, 6, 9 and 12% noise), which might counteract effects of mistuning and F0 by filling in spectral envelope. However, noise did not impact categorization. Experiment 3 extended F0 to 321 Hz to maximize its effects and included conditions that eliminated the critical harmonics. To be sensitive to perceived changes within a vowel category, listeners in Experiments 2 and 3 also rated “goodness-of-fit” with respect to the intended vowel . Across experiments, there were slight anchoring effects of vowel on categorization. More importantly, categorization accuracy (as well as goodness ratings in Exp. 3) was found to decrease with increased mistuning. This effect was even more pronounced when critical harmonics were removed in Exp. 3. Goodness ratings also varied with F0, but did not simply decrease as F0 increased as previously suggested. Rather, ratings depended upon the complex relationship between the positions of individual harmonics and F1/F2 center frequencies. These results collectively suggest that vowel perception depends upon whether the distribution of provided harmonics reinforces localized resonant frequencies.

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3:00

Function word perception depends on (a) speech cue(s) several syllables downstream

Meredith Brown* *University of Rochester*
Laura C. Dilley *Michigan State University*
Michael K. Tanenhaus *University of Rochester*

Speech perception depends on the ability to rapidly accommodate considerable variability in speech rate between speakers. We present results from three experiments indicating that listeners use context speech rate to generate provisional hypotheses about the timing and number of constituents in upcoming speech, and that they maintain probabilistic, fine-grained information about their initial percepts across multiple syllables and update these provisional hypotheses based on downstream prosodic cues. In two sentence-judgment experiments, 18 participants heard utterances containing polysyllabic nouns preceded by heavily-coarticulated indefinite articles and followed by [s]-initial words (e.g. ...saw (a) raccoon slowly...). We altered determiner duration to manipulate the likelihood of its perception (Dilley and Pitt, 2010). We also altered the speech rate of the [s] following the target word (Experiment 1) or of material distal to [s] (Experiment 2) to manipulate the likelihood that the item would be perceived as containing the plural morpheme –s. Participants were asked to select the mentioned referent within a display containing singular and plural alternatives. In both experiments, responses were significantly affected by the speech rate of both the determiner ($p<.0001$) and the sibilant ($p<.0001$) relative to surrounding context, demonstrating that determiner perception is influenced by gradient downstream information spanning multiple syllables. Experiment 3 examined time-course using the stimuli from Experiment 2. Eye-movements revealed rapid effects of determiner duration: Shorter determiners elicited higher proportions of fixations to plural target pictures than longer determiners prior to ($p=.052$) and after the processing of [s] ($p<.0005$), demonstrating that listeners used acoustic cues to the presence or absence of the determiner shortly after they became available. Importantly, they also made rapid use of the duration of [s] relative to context speech rate ($p<.0005$). These findings suggest that listeners maintain and update provisional speech-rate hypotheses across multiple morphophonemic units, consistent with data-explanation approaches to speech perception.

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3:40

Convergence in speech rate in scripted dialogues: Confederate influences the speech rate of naive participants

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Natalie Phillips *Centre for Research on Brain Language and Music*
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David McFarland *Centre for Research on Brain Language and Music*
University of Montreal, Department of Audiology
Debra Titone *McGill University, Department of Psychology*
Centre for Research on Brain Language and Music
Caroline Palmer *McGill University, Department of Psychology*
Centre for Research on Brain Language and Music

In conversation, people tend to exhibit convergence by matching each other's vocal productions in pitch, amplitude, and vowel shape. Less is known about convergence in speech rate. We examined how participants' speech rate was influenced by a confederate's speech rate while reading a scripted conversational dialogue together. Participants read two dialogues with a confederate who was instructed to speak at either a Fast or Slow rate for each dialogue. We hypothesized that participants' speech rates are faster when the confederate speaks at a Fast rate compared to a Slow rate. Audio recordings of each utterance were subjected to a beat extraction algorithm that extracted the inter-beat intervals (IBI) between stressed syllables, based on increases in energy summed across auditory frequency bands. The mean IBIs of participants and the confederate were compared between the Fast and Slow speech rate conditions. As hypothesized, participants' speech rates were significantly faster in the Fast condition than in the Slow condition, and IBI differences between the participants and confederate decreased over the course of each dialogue. To measure the influence of the confederate's speech rate on that of participants, cross-correlations were conducted between the participants' and confederate's mean IBI per utterance across each dialogue. High cross-correlations were demonstrated at Lag+1 (participant's utterance lagging the confederate's utterance) and Lag0 (participant's utterance immediately following the confederate's utterance), indicating that the confederate's rate influenced the participants' rate. Although significant correlations were also shown for Lag-1 (indicating the participants' rates influenced that of the confederate), Lag+1 and Lag0 were significantly greater than Lag-1, suggesting the confederate influenced the participants' rates more than vice-versa. Overall, results indicate that speech rate converges when people engage in a conversation guided by a written dialogue. Results are discussed in relation to oscillator models that propose people mutually adapt and synchronize with one another.

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4:00

Her voice lingers on and her memory is strategic: Effects of gender on directed forgetting

Hwajin Yang* *Singapore Management University*
Sujin Yang *The Catholic University of Korea*
Giho Park *Singapore-MIT Alliance for Research and Technology*

The literature on directed forgetting has employed exclusively visual words. Thus, the potentially interesting aspects of a spoken utterance, which include not only vocal cues (e.g., prosody) but also the speaker and the listener, have been neglected. This study demonstrates that prosody alone does not influence directed-forgetting effects, while the sex of the speaker and the listener significantly modulate directed-forgetting effects for spoken utterances. Specifically, forgetting costs were attenuated for female-spoken items compared to male-spoken items, and forgetting benefits were eliminated among female listeners but not among male listeners. These results suggest that information conveyed in a female voice draws attention to its distinct perceptual attributes, thus interfering with retention of the semantic meaning, while female listeners' superior capacity for processing the surface features of spoken utterances may predispose them to spontaneously employ adaptive strategies to retain content information despite distraction by perceptual features. Our findings underscore the importance of sex differences when processing spoken messages in directed forgetting.

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4:20

Panel Discussion: Recent Trends in (the Pursuit and Publication of) General Auditory Perception Research

Michael D. Hall* *James Madison University*
John Neuhoff* *The College of Wooster*
Peter Pfordresher* *SUNY Buffalo*

The conference organizers will lead a discussion of some potentially alarming changes in the promotion of new general research in auditory perception within the U.S. Panelists will initially present some data comparing current rates of publication for general auditory research within recognized perceptual journals with corresponding rates several years previous, with special attention being paid to impacts on the availability of lower-level perceptual work. This data will be coupled with some recent examples of more limited representation by general auditory researchers on editorial boards. Possible alternative explanations of these trends will be discussed, including (1) decreased national interest in these research areas (in terms of the number of active researchers and/or the size of the potential audience), (2) a shift in submissions to more specialized journals (along with an emphasis on applied research), and/or (3) changes in focus within publication outlets coinciding with changes in board membership. Current and long-term implications of these trends also will be considered.

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Poster session (11:50 AM – 1:10 PM)
Osgoode Ballroom and Sheraton Hall
(located on the lower concourse)

1

Exploring the Attentional Demands of Whispered Speech

Anne Pier Salverda *University of Rochester*
Meredith Brown *University of Rochester*
Jennifer Roche* *University of Rochester*

Whispered speech is often associated with privileged and/or important information, making speech mode a salient paralinguistic cue to the information value of a speaker's message. Here, we present evidence that whispered speech captures attention more readily than normal speech, following exposure to a speaker's normal voice. We adapted a paradigm developed by Salverda and Altmann (2011), who showed that visual referents of spoken words capture attention. Participants saw two monochrome line drawings of objects, and a central fixation cross. After a short delay, one object turned green. Participants were instructed to quickly fixate the green object. A task-irrelevant spoken word, which referred to one of the objects, was presented just prior to the color change. (Importantly, spoken words were not a valid cue to the targets, and listeners were told to ignore them altogether.) Speech mode was manipulated across the experiment. Eight participants heard normal speech in the first block and whispered speech in the second; eight participants encountered the reverse order. Results revealed an overall speech-object congruency effect: Saccade latencies were slower when the spoken word referred to the distractor object than when it referred to the target object, indicating attentional capture of the referent of the spoken word. Further, this congruency effect participated in a marginal three-way interaction with speech mode and block—note that we are currently testing more participants. In the first block, speech mode did not influence the congruency effect. However, in the second block, the congruency effect was much larger for whispered than for normal speech. These results suggest that whispered speech commands attention more strongly than normal speech, provided that the listener is familiar with the speaker's normal voice.

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2

Music exposure and acute stress recovery among young adults

Gabriela Ilie* *St. Michael's Hospital, Injury Prevention Research Office, Division of Neurosurgery*

With modern life stress becoming such an epidemic the goal of identifying behavioural interventions that reduce the intensity of acute stress responses has never been more essential. In a randomized experimental design we examined whether playing a simple and familiar melody on the iPhone for 10 minutes would facilitate stress recovery in a group of non-musicians attending undergraduate University studies. 54 participants were instructed how to play Twinkle, Twinkle, Little Star using the Smule Ocarina app on the iPhone (http://ocarina.smule.com), which involved distant blowing into the iPhone and using one's fingers to play different notes. One week after receiving instruction, participants were each randomly assigned to either an acute stress or a no-stress eliciting procedure. The acute stress group exhibited elevations in levels of stress hormone (cortisol) and negative mood and arousal (as measured by two self-report measures of mood and arousal) compared to the no-stress group. Participants in both groups were subsequently randomly assigned to one of the following 10 minute-long activities: playing Twinkle, Twinkle, Little Star on the iPhone Ocarina™, listening to a recording of this playing, or sitting in silence. Participants who played or listened to the ocarina during the stress recovery period showed significant decreases in cortisol levels compared to control. Participants in the no stress group who played the iPhone Ocarina™ showed significant increases in cortisol levels relative to participants who listened to it or sat in silence. The implications associated with using digital technology in Music Therapy for acute stress interventions are discussed.

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3

High and low working memory capacity individuals are equally distracted by surprise

Patrik Sörqvist* *University of Gävle*

People with high working memory capacity (WMC) are generally less susceptible to distraction than their low WMC counterparts. The purpose of this study was to investigate whether people with high and low WMC differ in how they respond to surprising background sound. The participants were requested to view visually-presented sequences of digits and to recall each sequence immediately after its presentation. Each sequence was accompanied by a task-irrelevant sequence of tones presented to the participants over headphones. In the beginning of the experiment (trial 1-16), the auditory sequence consisted of 21 identical tones. On trial 17, the middle tone (tone number 11) was exchanged with another tone that deviated in pitch. This deviant sequence was then repeated for the rest of the experiment (trial 18 and onwards). Serial recall was drastically impaired on trial 17, but was reestablished on trial 18 onwards. This pattern was approximately identical to participants with high and low WMC respectively. The experiment suggests that WMC does not determine the extent to which people respond to the first encounter with a deviating (or novel) event.

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4

School Acoustics: A Decisive Factor in the Learning Process

Robert Ljung* *University of Gävle*

The purpose of the study was to explore if room acoustics (long reverberation time) has an effect on recall performance of spoken words. An additional objective was to study the impact of participant´s working memory capacity on their performance in these test conditions. Method: Thirty-two participants completed a word recall test and a sentence recognition test. They repeated each item to ensure accurate identification. In order to measure the participants working memory capacity, a reading span test were used. Results: The results on the word recall task was significantly impaired by the test condition with long reverberation time. The effect was most evident in the primacy part of the word list. However, the study gave no evidence for an association between working memory capacity and recall performance. Discussion: The present experiment showed that a long reverberation time may disrupt memory of auditory information, including for words that have been correctly identified. This is essential to keep in mind when debating acoustical norms for classrooms and other premises where understanding and memory of spoken information is of importance.

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5

Temporal control of discrete and continuous movements in cello playing: The role of working memory

Pieter-Jan Maes* *McGill University*
Caroline Palmer *McGill University*
Marcelo Wanderley *McGill University*

Research on motor control and coordination suggests that discrete and continuous rhythmic movements rely on different systems of temporal control (Robertson et al., 1999; Studenka et al., 2012; Zelaznik et al., 2002, 2005). Discrete movements, as in staccato cello playing (disconnected bow movements) are thought to rely on explicit timing in which working memory is implicated, whereas continuous movements, as in legato cello playing (continuous bow movements), are thought to rely on implicit timing that emerges from the movement dynamics. We test this hypothesis by studying effects of a secondary working memory task on the temporal control of discrete and continuous movements in cello playing. Additionally, we examine effects of performance tempo, as studies suggest that working memory demands increase when the tempo of tone production slows significantly (Lewis & Miall, 2003). A dual-task experiment was conducted in which cellists produced simple melodies (primary task) with and without a concurrent working memory task (secondary task) in a synchronization-continuation paradigm. We hypothesized greater interference of the working memory task on the temporal control of staccato articulation (compared with legato articulation), as the primary and secondary tasks are assumed to rely on the same cognitive functions. Further, we hypothesised that this interaction would be more pronounced at slower tempi. The temporal variability of tone onsets in cellists' performances increased in the presence of the secondary task, and more so for discrete than for continuous movements. The expected enlargement of this effect for slower tempo production was obtained only for simpler sequences whose pitch-to-bow-direction mappings did not require additional working memory. Overall, these findings pinpoint working memory as distinguishing temporal control of discrete movements from that of continuous movements in the context of music performance.

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6

Psychophysiological Responses to Auditory Change: An Investigation of Pitch, Timbre, Tempo, Loudness and Duration Changes on Autonomic and Facial Motor Responses

Lorraine Chuen* *McMaster University*
David Sears *McGill University*
Stephen McAdams *McGill University*

In recent years, researchers interested in the emotional impact of music have interpreted various physiological responses measured during music listening as indicators of an affective response to music. However, the lack of specificity of physiological responses to emotional induction has yet to be addressed empirically: changes in physiology accompany a number of cognitive and perceptual processes that may be shaped by acoustic factors in music. Thus, the present study sought to examine the effect of simple changes in pitch, timbre, tempo, loudness and duration—changes pervasive in music listening—on the physiological and facial motor responses of listeners. Forty participants were presented with 5 blocks of 24 trials while attached to biosensors measuring respiration rate, heart rate, skin conductance, and facial activity of the smiling and frowning muscles. Each trial consisted of an isochronous sequence of 24 to 28 repeated synthesized bassoon-like tones. Depending on the block, each trial contained either no change or a change in: pitch (ascending intervals of M3, TT, M7), timbre (trumpet-like, French horn-like, oboe-harpsichord hybrid), loudness (increases of 5, 10, 15 dB), duration (450 ms, 300 ms, 150 ms), or tempo (IOI's of 600 ms, 500 ms, 429 ms) on a given target tone. An interrupted time-series analysis indicated that simple changes in pitch, timbre, loudness, tempo, and duration produced significant variations in heart rate. Changes in timbre, tempo and loudness also affected skin conductance levels. There were no effects of auditory change on facial activity, suggesting that somatic activation is less affected by auditory change in these parameters than physiological measures related to autonomic nervous system function. The present study should serve as a motivation for music researchers interested in interpreting physiological responses as emotional indices to also consider acoustic factors in music that may influence physiological functioning in the absence of induced emotions.

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7

Tricking the Ear: Using a Quadri-stable Auditory Illusion to Influence Sound Localization

Constance May Bainbridge* *MIT*
Wilma Alice Bainbridge *MIT*
Aude Oliva *MIT*

As we navigate in the world, auditory information helps to guide the way we perceive it. While a lot of spatial information can be gathered aurally, the human auditory system has its weaknesses. We have designed a quadri-stable auditory illusion that makes use of front-back confusion with volume changes to create varying perceptions of an object approaching towards and withdrawing from the listener. Observers can perceive the same sound as traveling: 1) front to back, 2) back to front, 3) coming from and returning to the front, and 4) coming from and returning to the back. To examine differences between this illusory sound and truly moving sounds, participants performed several psychophysics experiments in a symmetrical, customized chamber with four speakers positioned on the cardinal axes around them. When asked to rate their confidence in perceiving a sound cued by directional instructions, they gave equally high confidence for the real and illusory sounds (despite the illusion having no direction). Participants had no biases in what percept they tied with the illusion, and ultimately could not tell the illusion apart from the real moving sounds. These results demonstrate that this single sound can be used to manipulate a person's perception of sound space. This quadri-stable auditory illusion opens new opportunities in multimodal science, for studying the perceptual, cognitive, and neural representation of objects and space, as well as exploring multi-dimensional perceptual awareness.

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8

The consequence of harmonic enhancement on the perception of concurrent auditory objects in a complex sound

Brandi Lee Drisdelle* *Université de Montréal*
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When the frequency of one harmonic is briefly mistuned and then returned to the 'in-tune' frequency and phase, observers report hearing this harmonic as a separate tone long after the brief mistuning — this is known as harmonic enhancement. In a previous study, the consequence of harmonic enhancement on listeners' ability to detect a brief notch embedded in one of the harmonics was examined by placing the notch in a complex sound on either the same or a different harmonic than what was briefly mistuned. Listening to complex sounds with a transient mistuning of a harmonic causing enhancement (hearing the harmonic stand out), participants were better at detecting notches located later on the previously mistuned harmonic compared to notches placed on a harmonic that was not mistuned. The finding suggests that the enhanced harmonic becomes a perceptually distinct component within a complex sound to which attention can be differentially deployed. Here, this hypothesis is tested by reversing the auditory component in the sound that is mistuned. Specifically, instead of mistuning a single harmonic, all but one harmonic is transiently mistuned and subsequently a notch is presented. The task remains the same, where participants are to detect a brief notch. However, in this experiment the enhancement of the in-tuned harmonic is achieved by the mistuning of all the other harmonics within the complex sound. Thus the enhanced harmonic remains in tuned for the entirety of the sound. Using this experimental design, the consequence of harmonic enhancement on the perception of complex sounds is further established.

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9

Familiar, but I don't know about preference: Acquisition and generalization of modal pitch distributions

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Meghan Collett *Queen's University. Kingston, ON, Canada*
Niko Troje *Queen's University. Kingston, ON, Canada*
Lola Cuddy *Queen's University. Kingston, ON, Canada*

With sufficient exposure to melodies generated by a novel second-order rule system (Loui, Wessel & Hudson Kam, 2010) new melodies are recognized, thus demonstrating acquisition of the statistical regularities of the system. This study is concerned with a first-order rule system: pitch distribution. We explored an interaction between distinctiveness of the distribution and retrieval instructions (explicit or implicit) on melody recognition. Melodic sequences were created at three levels of distinctiveness using an algorithm provided by Smith and Schmuckler (2004). Sequences were randomly generated from Temperley's pitch model (2007) with the pitch profile of the Hypophrygian or Lydian mode (Huron, 2006). 82 participants with little or no formal music education were recruited. In the training phase of the experiment, all participants were exposed to 100 tone sequences generated from one of the two pitch distributions at one level of distinctiveness. The testing phase paired a melody from the exposed distribution with one from the unexposed distribution at each level of distinctiveness (10 trials per level of distinctiveness). Half of the participants were asked which melody they found more familiar (explicit retrieval instruction), the other half was asked which melody they preferred (implicit retrieval instruction). Participants under familiarity instructions performed significantly higher than chance but those under pleasantness instructions did not. Moreover, under familiarity instructions but not pleasantness instructions, level of distinctiveness was significant. The most distinctive level was considered most familiar, the least distinctive level least familiar. This demonstrates that participants could generalize the exposed pitch profile and is evidence for acquisition of a first-order rule system. Findings hint at dissociation between knowledge and affect, as suggested by Loui, Wessel, and Hudson Kam (2010).

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10

An Investigation of the Perceptual Experience of Syncopation

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Scott Barton *Worcester Polytechnic Institute*
Michael Kubovy *University of Virginia*

Syncopation is a term with a straightforward music theory definition: syncopation involves the placement of rhythmic stresses or accents where they wouldn't normally occur (e.g. on a weak beat or off-beat in a rhythmic pattern). However, this definition does little to account for our perceptual experience of syncopation, as it is only concerned with deviations from a set metric grid, rather than deviations from temporal expectancy. We are therefore interested in a reinterpretation of the definition of syncopation to include how we perceive syncopated patterns. We are interested in developing a metric for syncopation that involves expectancy rather than an adherence to a metric grid. Because understanding of syncopation relies on musical knowledge, we have attempted to develop perceptual studies that involve implicit measures of syncopation rather than explicitly asking listeners about their experience. Our tasks are designed to reveal whether people experience non-syncopated/expected notes differently than syncopated/unexpected notes. Several potential paradigms and preliminary results will be discussed.

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11

Beta- and gamma-band electroencephalographic activity indicates pulse in non-isochronous syncopated rhythms

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Paolo Ammirante *Ryerson University*
Frank Russo *Ryerson University*

Beta- and gamma-band electroencephalographic (EEG) activity as a neural representation of metric structure has been studied using isochronous sequences at different tempi (Fujioka, Trainor, Large, & Ross, 2012), with omissions (Fujioka, Trainor, Large, & Ross, 2009; Snyder & Large, 2005), and with timing perturbations (Zanto, Large, Fuchs, & Kelso, 2005). Complex syncopated patterns have been investigated using fMRI (Chapin et al., 2010), where activity in pulse-associated areas (i.e. basal ganglia and supplementary motor area [SMA]) has been observed, suggesting that an isochronous pulse can be extracted from a non-isochronous sequence. On the basis of this evidence, it seems reasonable to hypothesize that beta- and gamma-band oscillations should time-lock to the implied pulse in syncopated rhythms. Listeners were presented with standard and syncopated trials, each consisting of 3-tone cycles. For standard trials, the inter-onset-intervals (IOI) separating the three tones were 780ms, 390ms, and 390ms. For syncopated trials, the IOI's were 585ms, 585ms, and 390ms. This syncopated "3-3-2" rhythm strongly implies an underlying isochronous pulse (with an IOI of 390ms) despite only two of the three tone onsets being concurrent with the pulse. Time-frequency analysis of EEG in syncopated trials revealed that responses peaked at timepoints concurrent with the implied pulse and tone onsets, with latencies comparable to previous work (Snyder & Large, 2005; Zanto et al., 2005). These findings implicate beta- and gamma-band EEG activity in the perception of an implied pulse during a syncopated pattern. Since non-isochronous tone onsets are not oscillatory tracking them per se would go against the oscillatory nature of neuronal activity, making the case for tracking the implied oscillatory pulse.

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12

Attentional capture by sound disappearance

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Todd A. Mondor *University of Manitoba*

The current study investigated whether the abrupt disappearance of a sound can capture attention. Previous research has shown that the abrupt appearance of a sound can capture attention and evidence has also accumulated indicating that both the appearance and the disappearance of a visual object can capture attention. The possibility that the disappearance of a sound similarly captures attention has not yet been examined. In Experiment 1, participants were presented with a context sound in either the left or right channel that abruptly terminated 100 or 200 ms before the presentation of a target which could also be presented in either the left or right channel. Listeners were required to make a target discrimination based on pitch (high or low) in all three experiments. Under these conditions, participants responded more quickly when the target was presented in the same channel as the context sound for the 100 ms condition but not the 200 ms condition. In Experiment 2, two context sounds were presented dichotically. One of the context sounds terminated either 100 or 200 ms prior to a target, while the other terminated 25 ms prior to a target. Participants were found to respond more quickly when the target was presented in the same channel as the context sound that terminated 100 ms prior to its onset. Experiment 3 was similar to Experiment 2, except that the target could be presented at greater intervals following offset of context sounds. Listeners responded more quickly when the target was presented in the same channel as the context sound that terminated first even when the target is presented much later. Taken together the results of these three experiments suggest that attention is captured by the abrupt disappearance of a sound.

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13

Auditory-vocal crosstalk at the sequence-level: Evidence from the order incongruence effect in serial recall

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Paul Taylor *University of Central Lancashire,United Kingdom*
Jeannie Judge *University of Central Lancashire,United Kingdom*
Robert Hughes *Royal Holloway, University of London, United Kingdom*

It is well-established that the mere presence of an auditory sequence disrupts the capacity to recall a short list of verbal events even when that list is presented visually (visual-verbal serial recall). This is particularly the case when the order of concurrently presented irrelevant spoken items (e.g., 25917364) is incongruent with the order of items in the visual to-be-remembered list (e.g., 27465139), as compared with an order-congruent auditory sequence (but one staggered in time, i.e., 51392746) or an unrelated auditory sequence (e.g., a series of spoken letter-names; Hughes and Jones, 2005, Journal of Experimental Psychology: Human Perception and Performance, 31, 316-327). Hughes and Jones (2005) speculated that this order incongruence effect may be due to sequential perceptual-motor crosstalk: the incongruent auditory transitions intrude into the vocal-articulatory sequence-planning system co-opted to support the retention of the order of the to-be-remembered items. In the present study, we test a key prediction that follows from this account, namely, that the effect should be eliminated if vocal-articulatory sequencing cannot be used. Confiriming the prediction, we found that if participants were required to engage in (whispered) irrelevant concurrent articulation (or 'articulatory suppression')—thereby precluding vocal-articulatory sequencing of the list—disruption of serial recall by sound, including order-incongruent sound, disappeared. The results provide further support for the view that it is not the content of auditory items per se that endows them with disruptive power but rather their obligatory organisation into sequences (cf. Bregman, 1990) that can then interfere with goal-driven sequential motor behaviour.

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14

Communicating Emotion in Music: The Role of Mode, Pitch and Timing Cues

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The parallels in the communication of emotion within the domains of music and speech are a topic of strong interest. In addition to shared cues such as pitch height and timing, modality (i.e. "major" vs. "minor") can be a powerful cue in music. Previous work in the MAPLE Lab explored this link between emotion and music by comparing differences in the pitch and timing cues used in major and minor key pieces. The first study involved analyzing Bach's Well–Tempered Clavier (Book 1) finding a strong link between mode, pitch and timing such that pieces in major keys were higher and faster than their minor key counterparts. Here, we extend that work in two ways: (1) by comparing differences in tempi used by different performers and editors, and (2) by obtaining perceptual ratings (happy/sad) for each of the 48 pieces in this set. Intriguingly, despite considerable individual variation in tempo selection, our analysis revealed that major key performances were faster than minor key counterparts within each performer's recording, for all 20 instances (13 performers, 7 editors) examined. Currently we are extending this study by obtaining ratings of the emotional tenor of each of the 48 pieces to shed light on the degree to which the low-level cues extracted previously (i.e. pitch height and timing) predict perceived emotion. This will extend our research group's previous corpus analysis work and facilitate new explorations – such as comparing whether quantifications of timing based on either attacks-per-second or tempo better predict perceptual ratings of happiness/sadness. Together, we hope these ongoing studies will contribute to the rapidly growing literature on exploring parallels between music and speech.

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Auditory versus visual perception of gap size at the microscale level

Skyler Gentry* *Washburn University*
Michael K. Russell *Washburn University*

Traditionally, affordance experiments have focused on affordance tasks that require either the entire body or a full portion of an appendage (the macroscale level). The current study differs from previous investigations in that the focus is on affordance perception using only a portion of an appendage (the microscale level). More specifically, individuals will be required to judge the dimensions of the world with regard to the foot, hand, or head. Thus, the proposed study will allow for a comparison of various body parts in relation to the center of perception as well as in the use of actions. The proposed study will also examine the ability of individuals to use vision and audition in judging gap size. Each participant will complete 48 trials, with each trial requiring participants to judge whether a gap is large enough for the hand, foot, or head. Moreover, participants will be required to judge half of the gaps using vision and the other half using audition (hearing). The sound in both cases will be three 770 Hz square wave pure tones. The findings will be discussed in relation to the extent to which individuals are aware of the dimensions of body parts at the microscale level and how perception may be affected by the degree to which those body parts are used on a day-to-day basis. The extent of perceptual differences across modalities will also be discussed.

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16

Time-to-Arrival Detection within Virtual Acoustic Environments

Daniel Kobylarz* *William Paterson University*
Michael S. Gordon *William Paterson University*
Darlene Edewaard *William Paterson University*

Time-to-Arrival (TTA) detection is the determination of when an approaching object will reach one's position. Detection of TTA is critical to facilitate prospective actions and maintain one's safety in a dynamic environment. The current research was designed to investigate how the spatial and spectral properties of sounds might support effective TTA determinations. Specifically, participants were asked to determine the location of a sound travelling towards them within a virtual hallway from one of five directions (270°, 315°, 0°, 45°, 90°). The virtual hallway created a reverberant environment that permitted participants to orient their head/bodies to face each location. When facing the sound source's hallway the approaching sound was louder and interaurally balanced (relative to the lateral hallway facing positions). Results indicated that participants were more accurate and faster with sounds of particular spectra (e.g., higher centroid frequencies). Conclusions from this research suggest the difficulty locating the TTA sound sources, in addition to the advantage of detecting "urgent" spectral properties.

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17

Will it hit me or will I hit it? Perception of collision as a function of motion and modality

Delanie Atteberry* *Washburn University*
Michael K. Russell *Washburn University*

Under everyday circumstances, the world of perceiving-acting organisms is filled with moving and stationary objects. As can easily be imagined, the ability to detect a colliding object is necessary to avoid injury. Little research has been conducted in the auditory perception of collision. The research that has been conducted has focused on auditory targets moving towards a stationary observer. The current study focuses on the perception of collision under three different circumstances: (1) stationary target/stationary observer, (2) stationary target/moving observer, and (3) moving target/stationary observer. Each participant completed 72 trials. Half of the trials involved the use of audition in judging collision and the other half involved using vision. Participants were exposed to a target at nine different heights. Each height was presented four times in a random order. The task of the participant was to say yes if collision was imminent or no if not. The findings of the current study will be discussed in terms of the importance of motion on the perception of collision as well as the discrepancy between visual and auditory judgments. Discussion will also be given to the degree to which information that was created through motion supplements and enhances perceptual judgments.

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18

An evaluation of the role of vowel formant frequencies on the perception of foreign accent

Kit Ying Chan* *James Madison University*
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Previous studies (Sidaras, et al., 2009; Vieru, et al., 2010) have argued that formant center frequencies in vowels represent primary cues to foreign accent. The current investigation used resynthesis to manipulate vowel frequencies to evaluate their role on the perception of foreign accent in five monosyllabic English words (lash, lock, leave, lawn, and chute) produced by a native speaker of English and a Spanish-accented speaker. A series of five tokens were resynthesized for each native and accented word starting at the original sample's F1 and F2 center frequencies then moving in equal Mel steps to the values of the accented/native counterpart, while retaining the sample's vowel duration. Native English listeners rated both the degree of foreign accentedness and comprehensibility of these stimuli using a 7-point scale while viewing the intended word. Changes in vowel frequencies did not influence accentedness ratings for any words. The native "lawn" stimuli were rated as more accented due to an unintended change in perceived consonant, and therefore were excluded from remaining analyses. Overall, tokens modified from the accented words were rated as significantly more accented and difficult to understand than tokens modified from the native words. Thus, the acoustic characteristics of accent were successfully modeled by resynthesis. However, gradual changes in formant frequencies from native to accented values, or vice versa, had no significant impact on accentedness ratings. Changes from native frequency values had a slight negative impact on comprehensibility ratings as they approached values for the accented speaker, an effect that is likely due to a move toward an alternative vowel category. Taken collectively, these results contradict previous claims, suggesting that vowel formant center frequencies are not primary cues to foreign accent. Implications for future research on perceptual cues to accent (e.g., the potential role of dynamic cues) will be discussed.

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Change Deafness: Gradual Versus Abrupt Changes in Pitch of Human Voices

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Jordan Manley *Walsh University*
Erin Naumann *Walsh University*
Joseph Wayand* *Walsh University*

Change deafness (e.g., Vitevitch 2003) has received less of researchers' attention than has change blindness (e.g., Rensink, Regan, & O'Clark, 1997; Levin & Simons, 1997). We tested the auditory analog of both the change blindness flicker paradigm and the gradual scene change paradigm (Simons, Franconeri & Reimer, 2000). Fifty-six college students were randomly assigned to either an abrupt condition, a gradual condition, or a control condition. Via headphones, each participant listened to a recorded human voice that either abruptly shifted in pitch, gradually shifted in pitch, or did not change in pitch. The pitch shifts were created using sound editing software. The amount of overall pitch change was identical in both experimental conditions. The sole difference was the speed of the pitch change (abrupt vs. gradual). After listening, participants were asked whether they detected a change in the narrator's voice. In the abrupt condition, 11 out of 19 participants noticed the change. In the gradual condition, 0 out of 18 participants noticed the change in the paragraph, $x2(1, N = 37) = 14.83$, $p < .001$. We found evidence that listeners could miss both abrupt and gradual auditory changes, with gradual changes being particularly difficult to detect.

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Perceptual error is not an error: A Gibsonian, ecological interpretation of slippage

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Innumerable studies in auditory spatial perception (as well as other areas) suggest that human participants fail to perceive the world as it really is. Traditionally, the difference between a participant's judgment of the world and the actual state of the world is considered a perceptual error. In like fashion, slippage refers to the discrepancy "between the experience and that to which the experience refers," "between the object of reference and the object of experience" (Shaw, Turvey, & Mace, 1982). An alternative viewpoint is proposed and has a foundation in the Gibsonian, ecological perspective. That alternative perspective proposes that perceptual error is a misnomer and, rather than being a flaw of the participant, is better conceived of in terms of the concept of information and the zone of safe passage, an extension of Gibson and Crooks' (1938) notion of the field of safe travel. Investigations using an affordance paradigm will be discussed, with those studies involving the perception of sound source location across the three coordinates of distance, azimuth, and elevation. In brief, each of those studies have revealed that perceptual judgments, while not an exact replication of the physical world, support the idea that information and perception are reciprocal concepts and that error is actually advantageous to the organisms. Discussion will also be given to the possibility of using the alternative explanation in areas beyond spatial perception.

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Falling Stars: Acoustic Influences on Meteor Detection

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As can be attested by many a stargazer, when matter enters the earth's atmosphere it causes a burst of electromagnetic energy, including visible light and radio-wave emissions. While meteoric events tend to be quite brief (often less than 500 ms) their beauty in the night sky can create a lasting impression on a perceiver. While less popular, meteors often create an auditory event caused by the reflection of radio-waves from their plasma trails as they pass through the ionosphere. A signal from a distant transmitter can be picked up by a radio receiver in the form of a "ping" or a "bong," when a meteor passes in between. In this sense, meteors provide an interesting natural paradigm from which to better understand some general principles of auditory perception in a vigilance paradigm. Often radio astronomers are required to patiently listen to many minutes or even hours of signals waiting for meteors. With respect to that situation, this research investigated the detection of meteoric auditory events across an extended period of time. Participants heard a thirty-minute auditory recording of acoustic meteors embedded in background noise. During this period a series of radio meteors were presented to participants and they noted the time of their occurrence on a marking sheet. Comparisons across the initial, middle, and final ten minutes of the recording revealed that participants had a greater tendency to hear "phantom" sounds during the final ten minutes of the video. Results suggest the interaction of expectation with extended vigilance in producing acoustic meteor detection.

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Ability to synchronize to music predicts ability to synchronize with another person

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People can synchronize their movements with music and with the sound of another person's movements (Demos et al., 2011). Is the same mechanism responsible in each case? If so, then people who are better at synchronizing with music will also be better at synchronizing with another person. We tested this hypothesis by asking 38 participants to shake an egg-shaped maraca in time with a metronome, in time with music (both at 128 bpm), and in time with another participant. Each trial lasted for 45 seconds. The maraca generated a clear rhythmic sound that correlated directly with hand movements, which we measured with a wireless motion tracker. We used cross-correlation to measure the synchronization of participants' hand movements with the music, metronome, and the other person, using a 4-second partially overlapping windows. Participants also took the Advanced Measures of Audition Test (Gordon, 1989), a measure of tonal and rhythmic discriminative ability. We used mixed-effect models, adapted for dyads (Kenny, Kashy, & Cook, 2006), to assess the factors influencing interpersonal synchrony. Participants who synchronized more with the music and metronome also synchronized more with their partner. Synchronization with the partner increased over the course of a trial for participants with higher rhythmic discriminative ability, but not for those with lower discriminative ability. The mechanism responsible for interpersonal synchrony also appears to be responsible for synchronization with music and with a metronome and appears to depend on the ability to perceive rhythm.

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Skull Music: Influences of Head Resonant Frequencies on Musical Preferences

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The dense bones that form the skull create a resonant chamber surrounding the cochlea. While there is evidence from previous research suggesting that the resonant properties of the outer and middle ear might affect pitch preferences, little research has addressed the potential contribution of the skull's resonance. In order to address this issue a series of experiments examined listener music preferences with a set of unfamiliar, original melodies and a different group of listeners experienced sound samples from formally tonal Baroque music. These musical samples were transposed across the 12-major keys and compared directly with the resonance of the listeners skull relative to the tonic. While there are a number of factors that contribute to music preferences, we found a subtle influence of the skull. Specifically the results indicate that the mathematical relationship between the resonant frequency of the skull and the tonic of the musical key can indicate musical distaste (i.e., the least preferred musical keys). Again, while this relationship is modest, it seems that mathematical dissimilarity between the skull and tonic may inhibit musical preferences.

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Perception and Structure in Jazz Rhythm: Is Hearing Always Believing?

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The purpose of this study was to examine the effects of selected musical variables on the horizontal timing deviations (i.e., eighth note timing relationships), vertical timing deviations, (i.e., ensemble synchronicity), and note dynamics (i.e., syncopation) within the construct of improvised jazz rhythm and melody. Musical variables included metrical beat placement, melodic character, intervals, articulation, underlying harmony, and tempo. Results of the simultaneous multiple regression analyses revealed that: (1) intervals preceding and intervals succeeding the sample eighth notes had a statistically significant effect on eighth note durations, (2) articulation had a statistically significant effect on upbeat-beat ratio, (3) tempo had a statistically significant effect on note dynamics, and (4) large, negative correlations occurred between the relative timing onsets of soloist and bass, soloist and drums, and bass and drums. Preliminary data demonstrates a large discrepancy between acoustical properties of jazz syncopation and the perception of jazz syncopation.

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Hearing Research: Are we evaluating what we hear?

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The offset component of sound's temporal structure (i.e. amplitude envelope) can convey important information about the event producing it, such as materials used and force exerted. However, in experimental settings researchers frequently employ tones synthesized with abrupt offsets lacking this information. Our research team has demonstrated several perceptual differences when comparing 'flat' (i.e. sustained with an abrupt offset) vs. more naturalistic 'percussive' (i.e. exponentially decaying) tones in a variety of task such as audiovisual integration (Schutz, 2009), duration judgments (Schutz, Vallet, & Shore, 2012) and associative memory (Schutz & Stefanucci, 2010). Consequently, we became interested in determining the prevalence of flat and percussive tones in auditory perception research. Previously, our team surveyed the temporal structure of sounds used in Music Perception (Schutz & Vaisberg, in press) and Attention, Perception & Psychophysics (Gillard & Schutz, 2013). These surveys found that although many studies use flat sounds (average of 28.6%), a surprisingly high percentage use envelopes with unspecified temporal structures (44.9%). To expand this work, here we surveyed the journal Hearing Research, classifying sounds into 5 categories: "flat", "percussive", "click train" (i.e. a series or rapid sound bursts), "other" (i.e. sounds that did not fit into the previous categories) and "unspecified" (i.e. descriptions from which the temporal structure could not be discerned), to determine if this trend persists. Of the 98 articles surveyed, flat sounds represent a significant percentage, (42.5%), slightly larger than those not specifying temporal structure (40.2%). Consistent with our previous surveys, it is clear that (1) temporal structure has not been previously considered as an influential parameter affecting experimental outcomes, and (2) flat sounds are favored over sounds with meaningful offset information. Therefore we believe amplitude envelope is an under-explored attribute with great potential for fruitful future research.

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An Audio Feature Analysis of the Toronto Emotional Speech Set (TESS)

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Several studies have examined the role of different acoustic features that are important for the perception of emotional prosody in speech. Some studies within cognitive psychology have also highlighted the importance of acoustic features that are common to emotion recognition in both music and speech such as pitch accent and rhythmic stress. Various algorithmic and machine learning approaches have been applied for speech perception and recognition tasks (e.g. emotion classification) as well as emotional speech production tasks. However, relatively few of these approaches have been used for emotion identification in speech through the lens of musical emotion. In this study, we analyzed the Toronto emotional speech set (TESS) using 13 audio features, important for musical emotion prediction. These features ranged from low-level acoustic features to mid-level symbolic features involving timbre, pitch, rhythm, and dynamics. Our goal was to understand (a) if the same 13 features important for identifying musical emotion were sufficient for identifying speech emotion, and if so, (b) how these features differed in their relative contributions across various emotions. The TESS dataset consists of a total of 2800 stimuli comprising seven emotion categories, validated by human listeners: anger, disgust, fear, pleasant surprise, happiness, sadness, and neutral-ness. 200 emotion-neutral words are repeated in each emotion category by two female actors, one younger and one older, who are 26 and 64 years of age, respectively. Each stimulus consists of the same sentential context (i.e. “Say the word ___”) before each word. First, we performed statistical analyses to understand the effect of each audio feature on different emotions. Then, we trained neural networks to classify the emotion category of speech using the 13 audio features as inputs. We present our results and explore their implications for emotion recognition in speech.

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Motor simulation while judging sung melodic intervals

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Brain activity in the mirror-neuron system (MNS) while seeing and/or hearing actions of others is thought to reflect their motor simulation. Such activity has been proposed to underlie aspects of the listener's musical experience. In an experiment in progress, we are testing the hypothesis that judgments of musical structure involve a motor simulation of those actions that give rise to musical sound. Participants are presented with recordings of sung melodic intervals under audiovisual (AV), audio-alone (A), visual-alone (V), and control audio-visual (CAV) conditions, and then judge each interval's relative size. Visual stimuli are presented as point-light displays. CAV displays have been rendered biologically implausible by inverting the facial image and playing it in reverse. MNS activity is measured with an established EEG correlate: desynchronization of the mu rhythm (8-13 Hz) over central electrodes. Preliminary results show judgments are more strongly positively correlated with interval size for AV, A, and CAV than for the more challenging V condition. Mu desynchronization, on the other hand, has thus far only been observed in the V condition. This finding is at odds with previous studies involving passive observation, which show an increase of MNS activity for AV perception of action. Taken together, these findings imply that active engagement of the MNS is modulated by task-difficulty, and suggest a role for motor simulation in the perception of musical structure.

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