APCAM 2011

10th Annual Auditory Perception, Cognition, and Action Meeting

Thursday, November 3

Sheraton Seattle Hotel

Seattle, WA, USA

Program sponsored by

WASHBURN UNIVERSITY

Welcome to APCAM 2011

APCAM began as an idea to bring together researchers from various theoretical perspectives to present focused research on auditory cognition, perception, and aurally guided action. For the last ten years APCAM has retained its exclusive focus on the perceptual, cognitive, and behavioral aspects of audition. Many thanks to all those whose contributions have helped make APCAM such a success over the years. We would especially like to thank Washburn University. We are pleased to welcome you to the tenth annual Auditory Cognition, Perception, and Action Meeting. Enjoy your meeting!

Sincerely,

John Neuhoff
Michael D. Hall
Mike Russell
Devin McAuley
Peter Q. Pfordresher

History of APCAM

2010: St. Louis

2009: Boston

2008: Chicago

2007: Long Beach

2006: Houston

2005: Toronto

2004: Minneapolis

2003: Vancouver

2002: Kansas City

APCAM 2011 Schedule		
8:00	**Registration – Aspen Room**	
8:30	**Opening Remarks**	
	General (abstracts pages 7 – 8)	
8:40	Familiarity with Speech Affects Cortical Processing of Auditory Distance Cues and Increases Acuity	**Matthew Wisniewski*, Klaus Gramann Eduardo Mecado III Scott Makeig**
9:00	The Segmentation of Full Auditory Necklaces	**Minhong Yu* Michael Kubovy**
9:20	Auditory conflict adaptation: Moving towards dynamic accounts of processing	**Ben Dyson***
9:40	Auditory distraction: The resistible and the indomitable	**Robert Hughes* Mark Hurlstone Francois Vachon Dylan Jones**
10:00	**Break**	
	General, Applied, and Music (abstracts pages 9 – 11)	
10:20	A formant-based synthesizer for psychoacoustic research within Max for Live	**Michael Hall* Thomas Redpath**
10:40	Listener perception of single and multiple-shot small arms fire	**Jeremy Gaston* Kim Fluitt**
11:00	Measuring acoustic cue encoding and categorization during speech processing using the auditory N1 and P3 ERP components	**Joseph Toscano* Bob McMurray**
11:20	Metrical expectations influence spoken word recognition	**Meredith Brown* Anne Pier Salverda Laura Dilley Michael Tanenhaus**

11:40	False Hearing: Age-related changes in meta-audition	**Chad Rogers* Larry Jacoby Mitchell Sommers**
Poster Session (12 noon – 1:15 PM) Seattle Convention Center – Rooms 6A – 6C (6th floor) Abstracts located on pages 15 – 22		
Lunch (1:15 – 2:00 PM)		
Applied and Music (abstracts pages 11 – 13)		
2:00	Invited Presentation: Deep Neural Networks for Speech Recognition and Understanding	**Alex Acero**
2:20	Effects of delayed visual and auditory feedback on sequence production	**John Kulpa* Peter Pfordresher**
2:40	Movement and the auditory encoding of rhythm	**Devin McAuley***
3:00	Invited Presentation: The Virginia Merrill Bloedel Hearing Research Center: An Interdisciplinary Center for the Study of Hearing, Balance and Their Disorders.	**Jay T. Rubinstein**
3:20	**Break (20 min)**	
Music (abstracts pages 13 – 14)		
3:40	A Fröhlich Effect and Representational Gravity in Memory for Auditory Pitch	**Timothy Hubbard* Susan Ruppel**
4:00	Vocal Timbre Influences Memory for Melodies	**Michael Weiss* E. Glenn Schellenberg Sandra Trehub**
4:20	Last but not Least: Kahneman's Pleasure/Pain Function in the Domain of Music	**Kristopher Patten***
4:40	**Closing Remarks**	

Posters (abstracts located on pages 15 – 22)		
1	**Exploring the limits of object-based organisation in auditory memory using space, time and preparation**	**Ben Dyson***
2	**Examining modality dominance through modality switching costs and congruency analyses in an audio-visual task**	**Raj Sandhu* Ben Dyson**
3	**Does simultaneous presentation of speech through air, and across bone affect comprehension?**	**Ross Deas* Laura Curran Manohar Bance Jeremy Brown**
4	**Melodies and Lyrics: Interference from Automatic Activation or Recognition?**	**Jack Birchfield***
5	**Evidence of dedifferentiation of modality-specific language comprehension abilities in older adults**	**Lindsey Davies Lilienthal* Joel Myerson Sandra Hale Nancy Tye-Murray Mitchell Sommers Brent Spehar**
6	**Predicting Sensitivity to Spectrotemporal Variations from Cortical Activity**	**Cynthia Hunter* Estella Liu Leah Allen Barbara Church Eduardo Mecado III**
7	**Bach, Mozart and Beethoven – Listeners' perception of similarities and differences in their compositions.**	**Rachna Raman* Walter Dowling**
8	**Rhythm and Language: Perception of Familiar vs Unfamiliar Speech**	**Katherine Schiller* Sarah Mitchell John Neuhoff**
9	**Self-perception of pace: Does it matter who is walking near you and what you are doing?**	**Michael Russell***
10	**Is the Clave Pattern the "Key" to Salsa Music?**	**Laura Getz* Scott Barton Michael Kubovy**
11	**Dual processing strategy in interval judgments by Absolute Pitch observers**	**Malik Refaat* James Adelman Koen Lamberts**

12	**Effects of sequence timing on the perceived duration of auditory oddballs**	**Alan Wedd Elisa Kim Devin McAuley***
13	**Time production with gaps and dual task: Common mechanisms and transfer**	**Paule Ellefsen-Gauthier* Claudette Fortin**
14	**Decision Processes after Delayed Test Indicated by ERPs: Converging Evidence for Slow Feature Binding in Music**	**Walter Dowling* Shannon Layman**
15	**The temporal coordination of facial motion and vocal affect**	**Steven Livingstone* Caroline Palmer Marcelo Wanderley William Thompson**

8:40

Familiarity with Speech Affects Cortical Processing of Auditory Distance Cues and Increases Acuity

Matthew Wisniewski* *SUNY Buffalo*
Klaus Gramann *Swartz Center for Computational Neuroscience, UC San Diego*
Eduardo Mecado III *SUNY Buffalo*
Scott Makeig *Swartz Center for Computational Neuroscience, UC San Diego*

Several acoustic cues can contribute to auditory distance estimation. Non-acoustic cues such as familiarity may also play a role. We tested Participants' ability to categorize the distances of acoustically similar sounds that differed in familiarity. Participants were better able to judge the distances of familiar sounds. Electroencephalographic (EEG) recordings collected while participants performed this distance judgment task, analyzed using independent components analysis (ICA), revealed that cortical regions responded in different ways to acoustic inputs depending on the familiarity of sound, even when behavioral performance was comparable. Surprisingly, these differences were observed not only in auditory cortical regions, but in several other cortical regions as well.

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9:00

The Segmentation of Full Auditory Necklaces

Minhong Yu* *University of Virginia*
Michael Kubovy *University of Virginia*

In the current study, we investigated the principles of the segmentation of full auditory necklaces (repeating rhythmic patterns without gaps). Imagine the following auditory necklace (AN), …1112211211122112… where 1 represents one note and 2 represents another note with a different pitch. It could be perceived either as a repeating 11122112, 11211122, 22112111 or as a repeating 21112211. In our experiments, as soon as an AN was played, a circular array of icons appeared on the screen. During each beat, the corresponding icon was highlighted. The participants' task was to click on the icon corresponding to the beat they perceived as the starting point. Probabilistic models of the data showed that (1) the participants chose low-pitch notes as the starting point most of the time; (2) run and gap principles still work for full ANs. Therefore, for full auditory necklaces, the organization is a "figure-ground" problem + run and gap principle for figure pattern. All principles are additive.

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9:20

Auditory conflict adaptation: Moving towards dynamic accounts of processing

Ben Dyson* *Ryerson University*

Congruency between stimuli and / or responses represents a fundamental aspect of many traditional cognitive paradigms. Interest in congruency as a between-trial phenomenon has recently been expressed via contentious visual theories of conflict adaptation, where repeating congruency relations across trials (congruent-congruent, incongruent-incongruent) yield more efficient processing relative to when congruency relations are changed (congruent-incongruent, incongruent-congruent). However, such effects seem to be limited in the visual domain by those trials in which response is also held constant across trial. Auditory conflict adaptation was examined across four experiments, using a variety of different auditory dimension pairings (azimuth, elevation, pitch, loudness). In all cases, participants carried out selective attention tasks where, on any given trial, one auditory dimension was task-relevant and the other auditory dimension was task-irrelevant. Evidence for conflict adaptation was evaluated during both consecutive response-repeat and consecutive response-change trials. In contrast to the visual literature, significant effects of conflict adaptation were in effect during response change trials as well as during response repeat trials. The data reject the notion of the absolute presence or absence of conflict adaptation and embrace a dynamic account in which the reuse of information across consecutive trials is influenced by a number of experimental characteristics including speed of processing and dimensional interaction.

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9:40

Auditory distraction: The resistible and the indomitable

Robert Hughes* *Cardiff University*
Mark Hurlstone *Cardiff University*
Francois Vachon *Universite Laval*
Dylan Jones *Cardiff University*

We demonstrate that one, but not another, form of distraction by task-irrelevant auditory stimuli is amenable to top-down cognitive control. Attentional capture by an auditory deviant (e.g., a single female-spoken token following a sequence of male-spoken tokens) as indexed by its disruption of a focal, visually-presented, recall task, was abolished when focal task-load was increased by reducing the perceptual discriminability of the visual to-be-remembered stimuli. A forewarning about an imminent deviation produced the same effect as high task-load suggesting that both effects were mediated by a top-down capture-resistance mechanism, not a passive perceptual gating of the sound sequence. In contrast to the effect of a single deviant sound, distraction from continuously changing auditory stimuli (the classical 'changing-state effect') was not modulated by task-load or forewarning. The results suggest that whereas auditory distraction through attentional capture (deviation effect) can be brought under top-down control, distraction through competition-for-action (changing-state effect) is indomitable.

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10:20

A formant-based synthesizer for psychoacoustic research within Max for Live

Michael Hall* *James Madison University*
Thomas Redpath *James Madison University*

Psychoacoustic research often requires control of parameters within simplified stimuli that are analogous to musical instrument tones or spoken syllables. For example, at APCAM (Hall, 2009) we revealed that timbre recognition can occur given re-synthesized stimuli where spectral envelopes were impoverished by removing harmonics that did not coincide with spectral peaks. Establishing how much spectral flux information is necessary for instrument recognition further requires manipulation of spectro-temporal changes. Speech synthesizers have been used for these purposes, but include articulatory parameters that must be extracted to permit synthesis of musical tones, and typically have a cascaded filter branch that eliminates the high-frequency energy in many instrument tones. Available musical synthesizers also are problematic, with additive synthesizers allowing complete control at the cost of easy parameter manipulation, and subtractive synthesis containing too few filters to reasonably approximate natural spectra. A software-based formant synthesizer was created to address these issues while using analogous procedures to produce simplified instrument tones or impoverished voiced speech. The device allows up to three tunable (including user-defined) oscillators and/or noise to be passed through up to six band-pass filters in parallel, with linear interpolation between breakpoint values from tone onset to sustain, and sustained amplitude to release. Some independent control over amplitude envelopes, as well as (frequency and/or amplitude) modulation, is provided. The device was used to approximate tones from various instruments using spectral envelope measurements from just three time slices. While the results were synthetic, families of emulated instruments were generally conveyed. The device was programmed in Max for Live (a product for the Ableton Live sequencing package) as a monophonic instrument with complete MIDI control over all parameters. The device also can be easily ported to related stand-alone (Max/MSP) and free, open-source environments (Pure Data). Synthesis limitations, as well as plans for extension, will be discussed.

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10:40

Listener perception of single and multiple-shot small arms fire

Jeremy Gaston* *Army Research Laboratory*
Kim Fluitt *Army Research Laboratory*

Small arms fire is a complex impulsive sound event that can provide Soldier-listeners with important information about their operational environment, such as the approximate location, activities and resources of the enemy. Our initial work investigated listener perception of single-impulse events recorded from a fixed position behind a shooter. Under these conditions, listeners could reliably differentiate handgun from rifle fire, but listeners had difficulty distinguishing between different rifles. These listener conditions are not the best representation of small arms fire encountered in operational environments. Rather, multiple-shot automatic rifle fire from listening positions forward of the shooter are more typical. The present study represents a logical progression of this initial work by mapping listener perception across single and multiple-shot contexts from listener positions located downrange from the firing position. Initial results show relatively good performance for single-shot events, with performance systematically improving across three and six-shot contexts. The relationships between listener performance and the spectral and temporal properties of the weapons fire will be discussed.

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11:00

Measuring acoustic cue encoding and categorization during speech processing using the auditory N1 and P3 ERP components

Joseph Toscano* *University of Illinois*
Bob McMurray *University of Iowa*

An important question in speech perception is whether listeners encode speech sounds in terms of continuous acoustic cues at early stages of processing or whether they perceive them only in terms of categories. Although behavioral data show that listeners are sensitive to within-category acoustic differences, their responses are still generally shaped by phoneme categories, making this question difficult to answer. Recently, we have used the event-related brain potential (ERP) technique to examine cue encoding more directly (Toscano, McMurray, Dennhardt, & Luck, 2010, Psychological Science). We found that the amplitude of the auditory N1 component varies linearly with differences in voice onset time, a cue to word-initial voicing, suggesting that listeners encode continuous cues independently of categories. The later-occurring P3 component, in contrast, shows effects of both acoustic differences and phonological categories. Here, we ask whether the N1 may provide a general tool for studying cue encoding by examining ERP responses to other sets of speech sounds. Specifically, we asked whether we could observe differences in N1 amplitude for (1) naturally-produced, rather than synthesized, sounds; (2) spectral, rather than temporal, cues that distinguish other classes of phonemes (e.g., formant frequencies for vowels); and (3) word-medial acoustic differences. We also examined P3 responses, as well as the effect of task-defined phonological contrasts on the N1. The results show that differences in N1 amplitude can be clearly observed for some classes of speech sounds but are difficult to observe for others, though differences in P3 amplitude can still be seen. Thus, the N1 may serve as an index of cue encoding (in addition to other aspects of auditory processing identified by prior work). However, the specific speech sounds that we can study using this approach may depend on the complex link between the cues of interest and the neural generators of the N1.

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11:20

Metrical expectations influence spoken word recognition

Meredith Brown* *University of Rochester*
Anne Pier Salverda *University of Rochester*
Laura Dilley *Michigan State University*
Michael Tanenhaus *University of Rochester*

A growing body of work indicates that expectations about the acoustic realization of the phonemes and prosody of a speech utterance influence how listeners initially interpret incoming acoustic-phonetic cues during spoken word recognition. However, little is known about the types of representations that contribute to these perceptual expectations. We conducted two experiments using an eye-tracking paradigm commonly used to study the time course of spoken word recognition. The aim of our study was to determine whether perceived patterns across preceding portions of an utterance can influence expectations about the metrical organization of upcoming material within the speech stream. Experiment 1 verified that hearing the initial sounds of a word beginning with a strong-weak (SW) stress pattern, such as “jury”, can elicit transient activation of a phonemically overlapping word beginning with a weak-strong (WS) stress pattern, such as “giraffe”, and vice versa. Experiment 2 further demonstrated that metrical expectations based on preceding fundamental frequency and syllable timing patterns can influence the relative activation of competing SW and WS lexical alternatives. SW words were more strongly activated when their initial syllables were prosodically similar to preceding metrically strong syllables, whereas WS words were more strongly activated when their initial syllables were prosodically similar to preceding metrically weak syllables. These findings suggest that listeners’ expectations about the acoustic realization of an utterance include information about metrical organization and lexical stress, and that these expectations constrain the interpretation of acoustic-phonetic cues to lexical identity in the earliest moments of spoken word recognition.

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11:40

False Hearing: Age-related changes in meta-audition

Chad Rogers* *Brandeis University*
Larry Jacoby *Washington University in St. Louis*
Mitchell Sommers *Washington University in St. Louis*

Prior research has suggested that as people grow older, they use contextual information to compensate for their age-related hearing loss (Pichora-Fuller, 2008; Schneider, 2002; Wingfeld, Tun, & McCoy, 2005). This talk will review several experiments in which we tested how older adults' hearing changes in situations where context is misleading. To control for age differences in hearing acuity, we adjusted the level of noise masking according to each participant's speech reception threshold (SRT). In addition to accuracy, we incorporate metacognitive measures such as confidence and monitoring resolution to assess participants' meta-audition—their subjective experience of hearing. In our experiments, we found that older adults were more likely than young adults to falsely "hear" words favored by context and did so with extremely high confidence. Furthermore, older adults' confidence judgments were differentially sensitive than young adults' to changes in the amount of noise masking. Such a finding could relate to why older adults are frequently unhappy with their hearing aids, because hearing amplification increases sensory, not contextual information.

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2:00

Invited Presentation: Deep Neural Networks for Speech Recognition and Understanding

Alex Acero *Microsoft Research*

A renaissance of artificial neural networks is taking place due to recent theoretical developments and the availability of greatly increase computing power, including GPU processors. These new artificial neural networks often carry the name "deep" because of their ability to show improved results with more layers of hidden units. Deep neural networks (DNN) have shown very high accuracy in image recognition tasks and, more recently, in large vocabulary continuous speech recognition, challenging the traditional mixture Gaussian Hidden Markov Models which have dominated the field for the last 30 years. In this talk I will introduce such deep networks and present results. At the same time, while a lot of progress is being made in DNNs, there is a lot of room for improvement, especially around learning algorithms because the current algorithms are slow and only guarantee convergence to a local optimum. Many researchers in the area are now interested in learning from the neuroscience community and the cognitive psychology community to see whether alternate models proposed to explain how the human perception system works would be valuable.

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2:20

Effects of delayed visual and auditory feedback on sequence production

John Kulpa* *New Mexico State University*
Peter Pfordresher *University at Buffalo, The State University of New York*

This study represents the first systematic comparison of the relative contributions of auditory and visual feedback to sequence production. Our design allowed us to compare the merits of the sensorimotor conflict explanation of action disruption by altered feedback, as well as two newer theoretical perspectives. Participants learned an isochronous melody that they performed on a piano keyboard with their right hand. They attempted to perform this sequence at a prescribed rate while auditory and visual feedback were manipulated. A within-participants design was utilized, with a full 3x3 factorial crossing of these variables. The type of feedback presentation for each variable on any given trial was normal, absent, or delayed. Delayed auditory feedback (DAF) and delayed visual feedback (DVF) both tended to slow production of the sequence in comparison to the normal and absent conditions. These effects were additive. There was no modulation of the effect of delay in either modality by the absence of feedback in the other. In contrast with past research, DVF, but not DAF, increased timing variability. Motion analyses ruled out differences in salience of visual feedback across conditions as an explanation of the results. This study suggests that the effects of delayed feedback may be attributable to both sensorimotor interference and to conflicting information across feedback channels.

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2:40

Movement and the auditory encoding of rhythm

Devin McAuley* *Michigan State University*

This talk describes the results of four experiments that revisit the nature of a biasing effect of movement on the auditory encoding of rhythms reported by Trainor and colleagues (Phillips-Silver & Trainor, 2005, 2007, 2009). In the basic paradigm investigated by these authors, adult participants were given a training phase where they moved up and down with the experimenter in synchrony with an ambiguous auditory rhythm in either a duple (march-like) or triple (waltz-like) fashion. They were then given a test phase where they heard pairs of rhythms – one with a duple accent pattern and the other with a triple accent pattern – and chose which test rhythm was most similar to what they heard during training. Participants were found to overwhelming choose the test rhythm with an accent pattern that matched how they moved during training – leading the authors to conclude that form of movement during the training (duple or triple) influenced the encoding of the ambiguous rhythm. In the present study, the first two experiments used the same general design, stimuli and procedure, but show a failure to replicate the basic effect for both a random sample of undergraduate psychology students and two groups of participants with extensive experience moving to music (members of the ballroom dance team and members of the marching band). In a third experiment, the instructions were changed so that participants judged how they were bounced, rather than what they heard. Here, participants were able to reliably match the accent pattern of the test rhythms to the way they were bounced. In a fourth experiment, accent saliency was increased during the test phase. With this change, judgments about what participants heard during training matched how they were bounced – replicating the basic effect, but most participants on a post-experiment questionnaire also indicated that the experimenter expected them to respond in a manner that reflected how were bounced. Taken together, the four experiments suggest that participants remember how they were moved during the training phase, but that the form of their movement does not necessarily alter the auditory encoding of rhythm.

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3:00

Invited Presentation: The Virginia Merrill Bloedel Hearing Research Center: An Interdisciplinary Center for the Study of Hearing, Balance and Their Disorders.

Jay T Rubinstein *Virginia Merrill Bloedel Professor and Director*

The University of Washington's Virginia Merrill Bloedel Hearing Research Center brings together an interdisciplinary group of investigators to study hearing, hearing loss, and related communication disorders so that those who would, might hear. The Center is a communication focal point among basic and clinical scientists to facilitate the sharing of ideas and information for the collective advancement of auditory science and patient care.

The Virginia Merrill Bloedel Hearing Research Center is affiliated with the Department of Otolaryngology Head and Neck Surgery in the School of Medicine. However, as a multidisciplinary center, it has a strong affiliation with the College of Arts and Sciences and the Department of Speech and Hearing Sciences. In all, 15 University of Washington departments are represented in the Center.

Dr Rubinstein will discuss the history, structure and infrastructure, as well as the breadth of research studied by faculty affiliates of the Center.

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3:40

A Fröhlich Effect and Representational Gravity in Memory for Auditory Pitch

Timothy Hubbard* *Texas Christian University*
Susan Ruppel *University of South Carolina, Upstate*

Auditory pitch is often referred to in spatial terms, with pitches resulting from increased (faster) or decreased (slower) frequencies referred to as “higher” and “lower,” respectively. In the experiments reported here, memory for the initial pitch of an auditory target sequence that increased or decreased in frequency was examined, and whether memory for the initial pitch exhibited spatial biases consistent with spatial biases exhibited in memory for the initial location of a moving visual target in visual physical space was considered. Memory for the initial pitch was displaced forward in the direction of pitch motion, and this is consistent with a displacement pattern in studies of visual stimuli that is referred to as a “Fröhlich effect.” Forward displacement was reduced (but not eliminated) by an auditory cue that was presented before the target and that indicated the initial pitch, and forward displacement was smaller if a valid auditory cue was presented than if an invalid auditory cue was presented. However, a visual cue that indicated whether the initial pitch would be relatively low or relatively high did not influence forward displacement in memory for the initial pitch. Forward displacement was larger for descending pitch motion than for ascending pitch motion, and this is consistent with an influence of implied gravitational attraction in studies of visual stimuli that is referred to as “representational gravity.” The data suggest that the mental representation of auditory frequency space exhibits some of the same spatial biases that are exhibited in the mental representation of visual physical space.

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4:00

Vocal Timbre Influences Memory for Melodies

Michael Weiss* *University of Toronto*
E. Glenn Schellenberg *University of Toronto*
Sandra Trehub *University of Toronto*

Several studies have demonstrated that melody recognition is reduced when the timbre (instrument) changes between exposure and test, but no study has evaluated the possibility that different timbres have differential effects on melody recognition. The current study evaluated adults' recognition and liking of unfamiliar Irish melodies presented in four timbres: two familiar (voice, piano) and two less familiar (banjo, marimba). After exposure to a set of melodies, participants judged whether each melody from a larger set (original and novel) was old or new. Melodies presented vocally were remembered significantly better than those presented instrumentally even though they were liked less. The findings confirm that surface features of music and abstract, relational features are processed jointly as well as separately.

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4:20

Last but not Least: Kahneman's Pleasure/Pain Function in the Domain of Music

Kristopher Patten* *Arizona State University*

When a new song is heard, it may seem like every nuance and each movement is afforded equal attention. Logic implies that the deluge of acoustic information is compiled into a decision about preference for that song, but it remains to be tested how the ongoing temporal function of likeability during a song effects remembered likeability. The current study explores how temporal order in music may relate to remembered pleasure similar to Daniel Kahneman's findings of the relation between experienced pain and remembered pain. Participants in this experiment listened to four songs in two different conditions; one in which the amount of interesting acoustical information increased for a short period (enhancing the positive) and one in which a mistake was inserted into the song (enhancing the negative). To further explore the effect of processing level, participants were given different instructions that led to either a shallow, extrinsic measure of judgment or a deeper, intrinsic one (resulting in a design of 4 songs by 2 valences by 2 encoding levels). The results revealed that in the increased acoustical energy condition, there was a significant difference in remembered preference ratings, with significantly higher ratings for songs characterized by later-occuring positive energy increases. There was no difference in remembered likeability and no order effects in the negative mistake condition. The findings support Kahneman's model of memory in that likeability is dependent upon timing of stimuli, but in this case only with enhanced positive stimuli that is deeply processed. For this population, music with later-occuring enhancement is remembered significantly more favorably, mirroring Kahneman's findings with pain.

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Poster session (12 noon – 1:15 PM)
Seattle Convention Center – Rooms 6A – 6C (6th floor)

1

Exploring the limits of object-based organisation in auditory memory using space, time and preparation

Ben Dyson* *Ryerson University*

Remembering complex events involves the organisation of multiple pieces of information. While progress has been made regarding the role of object-based organization in vision, the extent of object-based organisation in audition remains largely unknown. Four experiments based on an auditory analog of Duncan (1984) are discussed examining the effects of space, time and preparation upon auditory object-based organisation. Experiment 1 showed that object-based organization is promoted when spatial separation between objects is used as an additional segregation cue. Experiment 2 demonstrated the role that temporal factors play in both the development and decay of object-based representations. Experiment 3 showed that providing participants with reliable information regarding the to-be-remembered attributes prior to scene presentation facilitated responding but did not reliably attenuate object-based organisation. Experiment 4 argued against an explanation of the data based on associational differences across conditions. The potential similarities and differences in object-based coding between vision and audition, and the extent to which the study of multi-modal object-based organisation might provide insights into how we organise and remember the phenomenology of everyday life are considered.

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2

Examining modality dominance through modality switching costs and congruency analyses in an audio-visual task

Raj Sandhu* *Ryerson University*
Ben Dyson *Ryerson University*

Competition between the senses can lead to modality dominance, where one sense influences multi-modal processing to a greater degree than another. Modality dominance can be influenced by task demands, speeds of processing, contextual influence and training. To resolve previous discrepancies in these factors, we assessed modality dominance in an audio-visual paradigm controlling for the first three factors while manipulating the fourth. Following a uni-modal task in which auditory and visual processing were equated, participants completed a pre-training selective attention bimodal task in which the congruency relationship and task-relevant modality changed across trials. Participants were given training in one modality prior to completing a post-training selective attention bimodal task similar to the first. The effects of training were non-specific as participants were speeded post-training relative to pre-training. Congruent stimuli relative to incongruent stimuli, also led to increased processing efficiency. RT data tended to reveal symmetric modality switching costs whereas the error rate data tended to reveal asymmetric modality switching costs in which switching from auditory to visual processing was particularly costly. The data suggest that when a number of safeguards are put in place to equate auditory and visual responding as far as possible, evidence for auditory dominance can arise.

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3

Does simultaneous presentation of speech through air, and across bone affect comprehension?

Ross Deas* *Dalhousie University*
Laura Curran *Dalhousie University*
Manohar Bance *Dalhousie University*
Jeremy Brown *Dalhousie University*

For patients with single sided deafness, contralateral routing of sound (CROS) devices are effective solutions for overcoming the head shadow effect. Bone conduction hearing aids, which transmit sound across the skull to the hearing cochlea, are a popular solution. It is known that transmission across the skull attenuates and delays signals in a frequency specific way. Thus, for patients with single sided deafness, speech signals reach the hearing cochlea through air, and also a slightly delayed and attenuated signal presented through bone. It is unclear whether simultaneous presentation through these mediums impairs comprehension. To investigate this, we compared speech in noise performance in ten patients with single sided deafness when the speech signals were routed through air alone, bone alone, or air and bone simultaneously. Performance intensity functions were obtained for each condition and results were examined to establish whether the combination of signals has a deleterious influence on performance.

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4

Melodies and Lyrics: Interference from Automatic Activation or Recognition?

Jack Birchfield* *University of Texas at Dallas*

This project examined whether hearing a melody could automatically activate retrieval of its associated lyrics. Previous research has produced conflicting results, and I proposed that relative familiarity of the musical stimuli could account for the different outcomes. To explore this premise, I conducted two experiments which controlled both for the familiarity of the musical items and for the presence or absence of lyrics. In Experiment 1, participants heard a random 9-digit sequence followed by one of five auditory distractors (highly familiar or less familiar vocal songs presented without their lyrics [HVNL and LVNL], familiar vocal songs with lyrics sung, familiar instrumental music, or white noise), then were asked to recall the digits in correct order. The prediction was that the lyrics would be activated and would interfere with rehearsal and retention of the digit sequences, thereby producing poorer recall performance compared to instrumental music or noise. However, no significant difference between HVNL songs and instrumental music was found, although recall levels in both conditions were reliably poorer compared to noise. Given that participants were engaged in a concurrent digit task, it was possible that they simply did not recognize the songs during test. Therefore, in Experiment 2 participants heard the song lyrics spoken before each trial (lyrics were created for the instrumental pieces). Results showed that the HVNL and LVNL conditions were not significantly different from noise, with performance in the instrumental condition marginally less than noise. That prior knowledge of the stimuli decreased interference to recall suggests that attentional distraction (associated with item recognition), rather than automatic activation of lyrics, might underlie that interference. Further research is needed to determine whether attentional distraction can also be evoked by novel songs.

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Evidence of dedifferentiation of modality-specific language comprehension abilities in older adults

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As people get older, their hearing declines as well as their ability to comprehend extended spoken passages. However, reading comprehension also declines with age, raising the question of whether the decline in spoken discourse comprehension is the result of hearing loss or whether it represents just one facet of an age-related decline in general cognitive ability. Accordingly, the current study examined the relations among auditory-visual discourse comprehension, auditory discourse comprehension, reading comprehension, vocabulary, and fluid intelligence in young and older adults. Overall, the ten correlations among these measures were stronger in the older adult group than in the younger adult group. Moreover, older adults' auditory and auditory-visual discourse comprehension were both strongly correlated with fluid intelligence, whereas neither of these correlations was significant in young adults. Statistically controlling for hearing did not affect the pattern of correlations for the older adult group. These results are consistent with a dedifferentiation hypothesis of cognitive aging (e.g., Baltes, Cornelius, Spiro, Nesselroade, & Willis, 1980) in which cognitive abilities become more strongly inter-correlated as people get older.

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Predicting Sensitivity to Spectrotemporal Variations from Cortical Activity

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Variations in auditory cortical processing are thought to contribute to individual differences in perceptual acuity. For speech sounds, this correspondence has been observed at the group level, for example, for N1-P2 peak-to-peak amplitude (Tremblay, Kraus, McGee, Ponton, and Otis, 2001) and MMN (Tremblay, Kraus, Carrell, and McGee, 1997) evoked potentials. Yet it has proven difficult to predict the acuity of individuals with these measures. We used measures of scalp potentials recorded when participants first experienced novel, spectro-temporally varying sounds. Sounds were either easy or difficult to discriminate from either a faster or slower baseline rate of spectro-temporal change. We used a large battery of ERP and EEG measures to try to predict forced-choice discrimination. Neural entrainment to rate in EEG recordings was observed for all stimuli. At the group level, the N1 component was present for easy contrasts at both slow and fast base rates. EEGs recorded during easy contrasts also showed a trend towards greater spectral power at frequencies less than 9 Hz. Despite large individual differences in performance for "hard" conditions, no measure reliably predicted individuals' acuity across conditions. Group-level differences in acuity can be seen in both ERP and EEG measures for novel, nonspeech, spectro-temporally varying sounds.

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Bach, Mozart and Beethoven – Listeners' perception of similarities and differences in their compositions.

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The present study investigated whether listeners' ratings of brief excerpts on bipolar adjective scales would reflect differences in the composers' styles, such that the pattern of ratings would differentiate the composers. Also, it investigated whether listeners would rate mechanically (MIDI) and naturally played excerpts similarly, and whether musical experience would impact ratings. Excerpts of keyboard music were chosen from three composers central to the western tradition – Bach, Mozart, and Beethoven. Stimuli consisted of 10-sec excerpts, 21 MIDI (seven from each composer), and 36 natural (12 from each composer). There were 26 participants in each study, including musicians, moderate musicians, and nonmusicians. Participants rated each excerpt on six bipolar scales. Statistical analyses were performed with an innovative multivariate technique, Discriminant Correspondence Analysis (DiCA). DiCA showed an effect of period and style of music based on participants' rating, which concurred with previous findings and music literature. Beethoven's MIDI excerpts were rated jagged, irregular, negative, fierce, plain, and simple, while his natural excerpts were considered complex, elegant, and irregular. In contrast to Beethoven, Bach's MIDI excerpts were marked elegant, regular, smooth, and positive, and his natural excerpts, simple. Mozart's MIDI excerpts were rated smooth, regular, gentle, simple, plain, and negative, whereas his natural excerpts received ratings of negative, plain, simple, and positive. In comparison with Mozart, Bach's MIDI excerpts were rated elegant, complex, irregular, jagged, fierce, and positive, and his natural stimuli were similarly considered as jagged and fierce. Nonmusicians rated excerpts similarly in both studies as complex and sophisticated. Moderate musicians rated excerpts as more neutral in both studies as compared with musicians' ratings. Also, nonmusicians' responses were reliably different from the other two groups in the MIDI (vs. the natural) study.

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Rhythm and Language: Perception of Familiar vs Unfamiliar Speech

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This study examined the effects of language familiarity on the perception of speech rhythm variability. Previous work showed that English speaking participants perceived the rhythmic variability French tokens to be more variable than English tokens, the opposite of what would be expected from acoustic determinants of French and English speech rhythms. In this study, native English speakers completed an online survey in which they listened to sixteen audio excerpts from the same script in English and French. In a 2x2x2 design, we manipulated language (English or French), direction (forwards or backwards) and acoustic source (voiced speech or white noise following the speech amplitude envelope. We found main effects for language (French was perceived as more variable than English), Direction (backward stimuli were perceived as more variable than forward), and source (noise was perceived as more variable than voices). We also found a significant interaction between sound source and direction, with a significant difference between forward and backward speech but no difference between forward and backward noise. The results suggest that familiarity with a language affects perceived speech rhythmic variability.

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Self-perception of pace: Does it matter who is walking near you and what you are doing?

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People typically prefer to walk at a particular pace (rate). That personal pace becomes quite obvious when we are walking with an individual who is walking much faster or slower than we normally do. To date, little is known about the ability of individuals to use sound to determine the pace at which they walk. Nonetheless, what we do know is that participants, under certain circumstances, are able to used sound to accurately report their personal walking pace. In natural settings, individual are often in motion when they walk and they are often in proximity to other individuals. Traditionally, participants are stationary when judging an auditory event. In natural settings, individuals frequently hear the footsteps of others as they themselves move about. Part I of this study determined whether the action of the observer impacts perception of self walking pace. Of interest is whether perception of self walking pace differs for stationary observers, observers moving their arms, and walking observers. Part II of this study sought to determine if the physical position of another individual impacted one's perceived pace. It can be imagined that individuals will perceive the walking pace of a person behind them as being faster than that of a person in front of them, despite the fact that both are walking at an identical pace. The possibility also exists that an individual will entrain their walking pace to that of another individual, when the relative pace of the two individuals is small. The findings of the proposed study will be discussed in terms of event perception in social settings. Discussion will also be given to the methodological nuances common to the vast majority of auditory investigations, which may be worth reconsideration.

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Is the Clave Pattern the "Key" to Salsa Music?

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Musicians contend that using the appropriate clave pattern is essential to the correct performance of different forms of salsa music. In bomba and merengue, a 3-2 clave pattern is appropriate, whereas a 2-3 pattern is appropriate in calypso and mambo; therefore, we refer to these two clave patterns as "natural." For our experiments, we created three additional less-syncopated patterns. We then superimposed each of these five patterns on various salsa recordings to explore the degree to which the appropriate clave pattern is in fact the "key" to salsa. Our data show that novices performed poorly; they were as likely to choose a non-syncopated control pattern as the natural patterns. Salsa dancers did better: they detected the relevance of syncopation, but were still unable to correctly choose between the natural forms (2-3 vs. 3-2). Musically-trained participants did well, which suggests that learning may be involved in properly perceiving the role of the clave in salsa music. In these experiments, musicians were not separated according to their familiarity with salsa patterns. Therefore, we will also report data on the performance of musically-trained participants with low vs. high salsa exposure, with the critical group being those with high training but low exposure. We will report one of three results: their performance will be (1) poor (like novices), (2) intermediate (like salsa dancers), or (3) good (like musicians with high exposure). Result (1) will imply that the distinction between the 2-3 and 3-2 clave is arbitrary in the sense that it is not implicit in the other non-clave layers of the music. Result (2) will imply an implicit understanding of syncopation only. Result (3) will imply that the clave is non-arbitrary, i.e., the 2-3 vs. 3-2 distinction is implicit in the other layers of the music.

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Dual processing strategy in interval judgments by Absolute Pitch observers

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Musicians identify the distance between pitches (intervals) using relative pitch (RP). All musicians learn RP through musical training and therefore have a good knowledge of intervals and how to identify them. Absolute pitch (AP) observers claim to use RP to identify intervals. The present study addresses the benefits to possessing AP in an interval identification task. Two synthesized piano tones were presented in series to highly trained APs and Non-APs and their RTs in identifying the intervals were recorded. The intervals presented ranged from the same note to an octave above or below. The participant was required only to say the name of the interval as a distance from the first to the second tone and not the direction. The RT profiles indicate a benefit of possessing AP in interval identification tasks and also that both AP and RP are used in APs judgment of intervals.

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Effects of sequence timing on the perceived duration of auditory oddballs

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When an unexpected (oddball) stimulus is presented within a series of otherwise identical auditory or visual (standard) stimuli, the duration of the oddball stimulus tends to be overestimated. Explanations of the oddball effect have proposed that distortion in the perceived duration of the oddball stimulus is due to increased attention to the unexpected oddball (Tse et al., 2004) or conversely, to repetition suppression in response to the repeated standard stimulus (Pariyadath & Eagleman, 2007). Two experiments examined the effects of sequence timing on the auditory oddball effect where the oddball stimulus was defined by a variation in pitch of one tone in an otherwise monotone sequence. In both experiments, the serial position of the oddball varied randomly from trial to trial across positions 5, 6, 7, or 8 and listeners judged whether the duration of the oddball stimulus was 'shorter' or 'longer' than the standard. In Experiment 1, the sequence of standard stimuli established a regular (isochronous) rhythm and the timing of the onset of the oddball was varied so that it was either 'early', 'on-time' or 'late' relative to the sequence rhythm. In Experiment 2, the sequence of standard stimuli had an irregular rhythm. Results showed that pitch oddballs that were 'early' were underestimated relative to pitch oddballs that were 'on-time' or 'late'. Results are inconsistent with both the enhanced attention and repetition suppression hypotheses, but rather support the view that in the auditory modality, the oddball effect in perceived duration reflects systematic interactions between the pitch and time characteristics of the sequence of stimuli.

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Time production with gaps and dual task: Common mechanisms and transfer

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When a gap is expected in an auditory signal to time, the signal duration is underestimated. In a time production paradigm, this effect results in a lengthening of produced intervals proportional to the pregap duration. This was interpreted in previous studies as a result of attentional time-sharing between timing and monitoring for the gap signal. A previous study showed that repeated practice of time production with gap led to an increase of the slope relating produced intervals to pregap duration, suggesting that practice influenced time-sharing abilities related to gap expectancy (Ellefsen-Gauthier, Fortin & Lacouture, 2008). The present study examined whether training of a time production task with gap could lead to an improvement in timesharing, which could then transfer to unpracticed dual task conditions. Twenty participants took part in seven sessions. In session 1 and session 7, dual task performance was assessed as participants produced a 2,5 s target interval signaled by a tone concurrently to a color judgment. During the five training sessions (Session 2 to 6), 10 participants practiced producing the target interval with gap; the remaining 10 participants produced the same interval in the dual task condition. The results parallel those found in previous studies on time production with gap, showing that produced intervals lengthened proportionally to the duration of attention sharing between timing and color judgment. Two major findings related to the effect of training are underlined. In both groups: 1) coefficients of variation of mean produced intervals decreased, showing an improvement of timing accuracy on dual task trials; 2) there was a similar, though marginal, increase in color judgment accuracy. These results suggest that expecting a gap in an auditory signal involves controlled aspects of attention that can be trained and transferred to dual task situations.

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Decision Processes after Delayed Test Indicated by ERPs: Converging Evidence for Slow Feature Binding in Music

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In a replication of the results of Dowling, Tillmann, & Ayers (Music Perception, 2001) we presented listeners with minuets. Memory for an initial phrase was tested after short (4 s) or long (12 s) delays. Test items were targets (copies of the phrase), lures in which the melodic contour was shifted along the scale, or lures in which a change of contour occurred on the 3rd or 4th note of the phrase. Listeners judged test items as the same or different from the initial phrases. Performance distinguishing targets from same-contour lures improved between short and long delays; listeners got better at rejecting same-contour lures. We think this is due to relatively slow feature binding during the delay, in which a detailed memory representation is formed (Tillmann & Dowling, Memory & Cognition, 2007). In a parallel EEG study we looked at ERPs to the point of contour change in the different-contour lures. We expected differences between the short and long delay before test, because, according to our theory, after the long delay the test item is being compared to a more elaborated memory representation than after the short delay. Our preliminary results show a negative ERP component in the latency range from 600 to 800 ms in the right fronto-lateral region, which we interpret as indicating decision processes. This component occurred more strongly in the long-delay condition, which is consistent with our hypothesis that a more complicated comparison is then being made.

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The temporal coordination of facial motion and vocal affect

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A pursing of the lips, a roll of the eyes, a furrowed brow; the face is a rich source of expressive information that 'speaks' through motion in addition to words. Over the last two decades, considerable research has focused on how the face and voice convey expressive information. However, the majority of these studies have studied these modalities independently, with less focus in how the face and voice coordinate during expressive vocal displays. We report two experiments on the role of facial expressions in the production and perception of emotions in speech and song. In Experiment 1, twelve singers with vocal experience spoke or sung statements with one of five emotional intentions (neutral, happy, very happy, sad and very sad). Participants were recorded with motion capture and a microphone. Functional Data Analyses were applied to marker trajectories for the eyebrow, lip corner, and jaw. Functional analyses of variance indicated significantly different trajectories across emotion conditions for all three facial markers. Analyses of vocal recordings indicated that jaw displacement and velocity was positively correlated with vocal intensity and speech rate. Extensive facial movements were also found to occur outside the timecourse of vocalization. The role of facial and vocal expression was examined in Experiment 2, in which participants judged the emotional valence of recordings of speaker-singers from Experiment 1. Listeners either saw (audio-only), heard (video-only) or both saw and heard (fullAV) the emotional intentions (neutral, very happy, very sad) of vocalists. Preliminary results indicate that participants were highly accurate at identifying emotions during video-only and fullAV, but were less accurate for audio-only sung expressions. These findings suggest that facial expressions play a central role in vocal emotional communication, transcending differences in production-type demands.

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