

APCAM 2008

**7th Annual Auditory Perception, Cognition, and
Action Meeting**

Thursday November 13

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Welcome to APCAM 2008

We are pleased to welcome you to the seventh annual Auditory Cognition, Perception, and Action Meeting (APCAM). The goal of APCAM is to bring together researchers from various theoretical perspectives to present focused research on auditory cognition, perception, and aurally guided action. APCAM is a unique meeting in 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. We would also like to thank our keynote speaker Dr. Beverly Wright, The College of Wooster, Wabash University, and in particular the laboratory of Dylan Jones at Cardiff University for their generous support. Enjoy your meeting!

Sincerely,

John Neuhoff
Devin McAuley
Peter Pfordresher
Mike Russell

APCAM 2008 Schedule		
7:30	Registration	
8:00	Opening Remarks	
<i>Attention and Localization (abstracts page 7)</i>		
8:10	Auditory attentional capture: Dissociations between objective and subjective indices	Jessica K. Ljungberg Robert W. Hughes Bill Macken Dylan M. Jones
8:30	Interference by Process, Not Content, Determines Semantic Auditory Distraction	John Marsh Robert Hughes Dylan Jones
8:50	The salience of dynamic sound localization cues as a function of head velocity and stimulus frequency	Ewan A. Macpherson Devin Kerr
9:10	Break (10 min)	
<i>Melody (abstracts page 8)</i>		
9:20	Are Melodies Remembered as Contour-Plus-Intervals or as Contour-Plus-Pitches?	Jay Dowling
9:40	Melody recognition is incremental and absolute	Sarah C. Creel Melanie A. Tumlin
10:00	Shifting perceptions: Developmental changes in representations of melody	Stephanie M. Stalinski E. Glenn Schellenberg
10:20	Break (10 min)	
<i>Rhythm & Action (abstracts pages 9 & 10)</i>		
10:30	The pulse of music and the pulse of the heart: A systematic investigation into the impact of tempo on cardiophysiology	Robert J. Ellis John J. Sollers Julian F. Thayer
10:50	Segregated in Perception, Integrated for Action: Immunity of Rhythmic Sensorimotor Coordination to Auditory Stream Segregation	Bruno H. Repp
11:10	After-effects of delayed auditory feedback	Peter Q. Pfordresher John D. Kulpa
11:30	It's all in the timing: Interpersonal synchrony increases affiliation	Michael J. Hove Jane L. Risen
11:50	Lunch & Poster Session	

2:00	Keynote Address (<i>abstract page 11</i>) Auditory perceptual learning: Stability vs. plasticity Beverly A. Wright Northwestern University,	
3:00 Break (10 min)		
<i>Objects & Environments (abstracts page 12)</i>		
3:10	The role of Auditory Backward Recognition Masking in natural listening conditions	Richard E. Pastore Jesse D. Flint Brandon J. Bassile Jeremy R. Gaston
3:30	Temporal weighting of auditory spatial cues	G. Christopher Stecker Andrew D. Brown
3:50	Object-based Auditory Memory: The Assessment of Preparatory, Spatial and Temporal Constraints	Benjamin J. Dyson
4:10 Break (10 min)		
<i>Speech & Memory (abstracts page 13)</i>		
4:20	Towards Neurophysiological Correlates of Acoustic Short-Term Memory	Christine Lefebvre François Vachon Stephan Grimault Synthia Guimond Robert Zatorre Isabelle Peretz Pierre Jolicoeur
4:40	Speaker normalization using cortical strip maps: A neural model for steady state vowel identification	Heather Ames Stephen Grossberg
5:00	Vowel Discrimination by English, French and Turkish Speakers: Evidence for an Exemplar-Based Approach to Speech Perception	Marc Ettlinger Keith Johnson
5:20	Closing Remarks	
5:30-6:30 Social Hour (Cash bar)		

Posters (abstracts located on pages 14 – 23)		
1	Congruent audiovisual dynamics facilitate perception of looming stimuli	Estella H. Liu Barbara A. Church Eduardo Mercado III
2	Qualifying the Chills Response: Differences between Transient and Prolonged Chills in Response to Music	Valorie Salimpoor* Mitchel Benovoy Gregory Longo Robert Zatorre
3	Serial memory for lists of spoken words: The impact of distributing voices in space	Cindy Chamberland* Catherine Mimeau Sébastien Tremblay
4	Lexical salience and temporal dips: How does clear speech act as a masker?	Lauren Calandruccio* Nah Eun Kim Sumitrajit Dhar Ann Bradlow
5	Play It Again, Sam	Whitney Sims Melissa Jungers
6	Does personality modulate interference in an auditory Stroop task?	Chris Tysiaczny* Edward Johnson Todd Mondor
7	Limits on the number of concurrent auditory streams in arpeggiated tone sequences	Michael Hall* Jonathan Schuett
8	Perception of sound source motion in a cluttered setting	Michael Russell*
9	Is the observer an important variable in understanding auditory distance perception?	Shannon Bechard* Michael Russell
10	Sound localization in noise: Why do people perform differently ?	Guillaume Andéol* Annie Moulin Lionel Pellieux Anne Guillaume Sophie Savel
11	Human psychophysics of spectral and temporal modulations and their interaction: A systematic approach to the processing of dynamic ripples	Manon Grube* Paul Eastaugh Tm Griffiths
12	Between-ear gap detection and the perception of dichotic continuity	Ian Harrington*
13	Relationship between Novel Music and Emotional Dimensions	Janel Goodman Ellen Campana Isaac Wallis Todd Ingalls
14	Vocal imitation of speech and song	James Mantell* Peter Pfordresher
15	The Role of Sparse Representation in Learning Musical Structure	Kat Agres* Jordan DeLong Michael Spivey
16	Duration as a cue to lexical identity in spoken word recognition	Christopher Weinland Louis Vinke Molly Henry Laura Dilley*

17	Effects of Tempo on the Perceived Complexity of Auditory Rhythms	Louis Vinke* John McAuley
18	Informative tones receive enhanced processing: Electrophysiological evidence from the auditory P2 event-related potential	François Vachon* Christine Lefebvre Stephan Grimault Synthia Guimond Pierre Jolicoeur
19	Effective Earcons for Use in Dual Tasks with Spoken Language	Terri Bonebright*
20	Factors mediating effects of rhythm context on duration-discrimination performance	Nathaniel Miller* John McAuley
21	Effectiveness of Changing Amplitude and Cue Validity On Aurally Cued Visual Search Performance	Katsumi Minakata Thomas Z. Strybel
22	Relative contributions of spectral and temporal dimensions to the identification of musical instrument timbres	Michael Hall* James Beauchamp
23	Broadening the notion of cross-modal causality	Michael Schutz* Michael Kubovy
24	Developmental changes in liking for and identification of emotion in music	Patrick G. Hunter E. Glenn Schellenberg* Stephanie M. Stalinski
25	Perception of rapid speech in aging listeners	Sridhar Krishnamurti*
26	The Role of a Change Heuristic in Judgments of Sound Duration and Intensity	Launa C. Leboe Todd A. Mondor
27	A smile is just a smile: Audiovisual speech detection from an emoting face	Mary Kolbusz Michael Gordon
28	Survival of the Fittest: Physical Fitness and Auditory Looming Perception	Josh Clark Katie Long Becca Worthington John G. Neuhoff

8:10

Auditory attentional capture: Dissociations between objective and subjective indices

Jessica K Ljungberg
Robert W Hughes
Bill Macken
Dylan M Jones

Luleå Technical University, Division of Engineering Psychology
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With relevance to auditory alarm design, we examined whether the semanticity of spoken words and their intonation-style (“urgent” vs. “non-urgent”) modulate the extent to which words capture attention from a visually-presented serial recall task and whether these behavioural effects map onto subjective ratings of the extent to which the sounds were “urgent” and “attention grabbing”. Compared to quiet or a repeated tone, the infrequent presentation of a spoken word captured attention—as indexed by an impairment of serial recall—but there were no effects of semanticity or intonation. However, action words were rated as more urgent and attention-grabbing than neutral words which were rated as more urgent and attention-grabbing than non-words. “urgent” words were also rated higher in urgency and attention grabbing than “non-urgent” words regardless of valence. In conclusion it is argued there is a dissociation between subjective and objective measurements.

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8:30

Interference by Process, Not Content, Determines Semantic Auditory Distraction

John Marsh
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Distraction by irrelevant background sound of visually-based cognitive tasks illustrates the vulnerability of attentional selectivity across modalities. Four experiments centred on auditory distraction during tests of memory for visually-presented semantic information. Meaningful irrelevant speech disrupted the free recall of semantic category-exemplars more than meaningless irrelevant sound (Experiment 1). This effect was exacerbated when the irrelevant speech was semantically related to the to-be-remembered material (Experiment 2). Importantly, however, these effects of meaningfulness and semantic relatedness were shown to arise only when instructions emphasized recall by category rather than by serial order (Experiments 3 and 4). The results favor a process-oriented, rather than a structural, approach to the breakdown of attentional selectivity and forgetting: Performance is impaired by the similarity of process brought to bear on the relevant and irrelevant material, not the similarity in item content.

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8:50

The salience of dynamic sound localization cues as a function of head velocity and stimulus frequency.

Ewan A. Macpherson
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Dynamic information about front/rear sound-source location is provided by the motion of the head and the resulting changes in interaural time-difference (ITD) and interaural level-difference (ILD). We measured the minimum head movement angle (MHMA) required for normally hearing human listeners to discriminate front and rear sources when stimuli were narrow bands of low- (0.5-1 kHz) and high- (6-6.5 kHz) frequency noise that were not correctly localizable in the absence of head motion. Targets were presented while the head was in motion at velocities between 50 and 400 deg/s, and were gated on and off as the head passed through a variable-width spatial window. Dynamic cues substantially aided only low-frequency performance. At 50 deg/s, the MHMA for low-frequency noise was ~5 degrees, increasing to ~25 degrees at 400 deg/s. For the high-frequency noise, the MHMA was ~40 degrees at 50 deg/s and unmeasurable at higher velocities. The results are consistent with the hypothesis that low-frequency ITD, and not high-frequency ILD, is the most salient dynamic cue. The observed increase in MHMA with head velocity parallels the commonly-found decrease in auditory sensitivity to source motion at high source velocities. Low-frequency performance was best predicted by stimulus duration regardless of head velocity.

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9:20

Are Melodies Remembered as Contour-Plus-Intervals or as Contour-Plus-Pitches?

Jay Dowling*University of Texas at Dallas*

A widespread view I once shared holds that melodies are represented in memory as pitch and rhythmic contour plus the pattern of pitch intervals among the notes. In contrast, I now believe that that representation consists of the contour, plus pitches represented as tonal scale values in a “movable do” system. I review psychophysical, music perceptual, and ERP evidence to this effect, and report a new experiment. Listeners heard familiar tunes and responded quickly to wrong notes, which were either 1 or 2 ST from the correct target, within the diatonic scale or not, and on or off the beat. Nonscale notes produced faster RTs, especially on the beat. There was no simple effect of interval size, which interacted with the other variables. (For example, off-beat nonscale notes 1 ST from targets—typical of “ornamental” grace notes—produced slow RTs. These results favor the importance of scale values over intervals.

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9:40

Melody recognition is incremental and absolute

Sarah C. Creel*UC San Diego***Melanie A. Tumlin***UC San Diego*

When listeners hear spoken words, recognition is rapid and “incremental”: listeners look preferentially to named objects (“candy”) as soon as any acoustic evidence occurs (“can-“). Less is known about melody recognition (though see Schellenberg and colleagues’ work). Our study is the first demonstration that absolute pitch information facilitates recognition on-line, before relative pitch information is available. Borrowing a paradigm from word learning, N=12 listeners learned melody “labels” for 16 unfamiliar objects. Each melody matched another in interval content until the last note. Matches were either absolute (CDEFG; CDEFE), or relative (CDEFG; F#G#A#BA#). After achieving 95% correct identification performance, listeners heard melodies and selected the correct picture (of two) without feedback as we measured eye movements. Looks to pitch-mismatched correct objects increased even before the two melodies diverged, while pitch-matched correct looks increased rapidly after the last note. Thus, melody recognition is both incremental and sensitive to absolute acoustic detail.

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10:00

Shifting perceptions: Developmental changes in representations of melody

Stephanie M. Stalinski*University of Toronto***E. Glenn Schellenberg***University of Toronto*

Scholars have proposed that humans begin life predisposed to process pitch absolutely and that this ability fades over development in favor of relational pitch processing. There is abundant evidence, however, for absolute and relational processing of pitch among listeners of all ages (infants, children, and adults). We devised a task in which absolute and relational cues were varied orthogonally. Children 5 to 12 years of age heard pairs of melodies that varied in pitch relations and/or pitch level and rated how different they sounded on a scale from 1 (exactly the same) to 5 (very different). In line with the hypothesis of an absolute-to-relative shift, the youngest listeners focused on changes in pitch level (i.e., absolute cues) as a source of perceived differences. With increasing age, changes in pitch relations played an increasingly important role.

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10:30

The pulse of music and the pulse of the heart: A systematic investigation into the impact of tempo on cardiophysiology.

Robert J. Ellis
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Empirical investigations of subjective and cardiac responses to music date back over 125 years. Perhaps the most commonly-investigated aspect of music is tempo, which is linked with subjective ratings of arousal and increases in mean heart rate (HR). However, the previous literature is plagued with two pitfalls. First, most physiological investigations of music do not experimentally manipulate tempo, but rather look for differences in physiological response between pieces of music and deduce a tempo effect post hoc. Thus, the precise contribution of tempo to cardiac change is largely unknown. Second, the utility of measuring mean heart rate changes to different pieces of music is not particularly strong; while a number of studies report differences in HR as a function of music, almost an equal number find no significant differences in HR. I review evidence showing that two other, less frequently investigated indices of cardiac activity (HR variability and phasic HR) may provide better windows into cardiac response to music. HR variability is a precise measure of parasympathetic (restorative) nervous system activity, and is associated with organism health and well-being. Phasic HR reveals moment-to-moment cardiac changes, in this case to music onset. In the present work, I systematically varied the tempo of MIDI performances of ragtime music (60, 90, 120 bpm). Experiment 1 examined HR variability to extended (2.5-m) excerpts of music that varied in tempo, and revealed that HR variability decreased as music increased, suggesting greater physiological activation with faster music. Experiment 2 examined phasic HR responses to shorter (12–16-s) excerpts of music, and revealed increases in phasic activity to faster tempo, indicating that tempo affects the heart within a few moments. These novel findings reflect the success of the experimental manipulation, and pave the way for additional investigations of musical properties.

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10:50

Segregated in Perception, Integrated for Action: Immunity of Rhythmic Sensorimotor Coordination to Auditory Stream Segregation.

Bruno H. Repp

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The present study assessed stream segregation in perceptual and sensorimotor tasks, using identical ABBABB... sequences. The perceptual task required detection of single phase-shifted A tones; this was expected to be facilitated by the presence of B tones unless segregation occurs. The sensorimotor task required tapping in synchrony with the A tones; here the phase correction response (PCR) to shifted A tones was expected to be inhibited by B tones unless segregation occurs. Two sequence tempi and three pitch separations (2, 10, and 48 semitones) were used with musically trained participants. Facilitation of perception occurred only at the smallest pitch separation, whereas the PCR was reduced equally at all separations. These results indicate that auditory action control is immune to perceptual stream segregation, at least in musicians. This may help musicians coordinate with diverse instruments in ensemble playing.

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11:10

After-effects of delayed auditory feedback

Peter Q. Pfordresher
John D. Kulpa

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It is well known that delayed auditory feedback (DAF) disrupts the timing of rhythmic sequences, usually with a lengthening of inter-response intervals (IRIs). The current research addresses whether DAF disrupts the phase or period component of an internal timekeeper. We report the results of two experiments involving tapping (Experiment 1) and piano performance (Experiment 2). Each trial of each experiment comprised 3 phases. Phase 1 involved synchronization followed by continuation with normal feedback. In phase 2 participants continued while experiencing DAF on a varying number of continuous events. In phase 3 DAF was removed and participants performed either with normal auditory feedback or with no auditory feedback. Analyses of timing suggest that DAF disrupts phase, in that its effect was instantaneous, transient (reversing after withdrawal of DAF), and not influenced by the number of delayed events. Moreover, people typically sped up (relative to synchronization) following DAF withdrawal.

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11:30

It's all in the timing: Interpersonal synchrony increases affiliation.

Michael J. Hove
Jane L. Risen

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The tendency to mimic and synchronize with others is well established. Although mimicry has been shown to lead to affiliation between co-actors, the effect of interpersonal synchrony on affiliation remains an open question. The authors investigated the relationship by having participants and an experimenter match finger movements with a visual moving metronome; participants and the experimenter could hear one another's tapping. In Experiment 1, affiliation ratings were examined based on the extent to which participants tapped in synchrony with the experimenter. In Experiment 2, synchrony was manipulated. Affiliation ratings were compared for an experimenter who either a) tapped to a metronome that was synchronous to the participant's metronome, b) tapped to a metronome that was asynchronous, or c) did not tap. As hypothesized, in both studies, the degree of interpersonal synchrony predicted subsequent affiliation ratings. Experiment 3 found that the affiliative effects were unique to interpersonal synchrony. We interpret these results in terms of tight perception-action links and representational overlap between self and other; and suggest that music and dance evolved as a tool to promote social cohesion.

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2:00 KEYNOTE ADDRESS

Auditory perceptual learning: Stability vs. plasticity

Beverly A. Wright

Northwestern University

Performance on many perceptual tasks improves with practice even in adults, indicating that our sensory systems are not rigid, but rather can be changed through experience. We have been using behavioural techniques to determine the circumstances under which learning on a variety of auditory tasks occurs (plasticity) and those in which it does not (stability). I will focus on three inferences about the neural underpinnings of perceptual learning that arise from our data: (1) Consolidation--the transfer of learning to long-term memory--functions as an all-or-none process. (2) Performance of the task to be learned enables neural modification, but once enabled, modification can be enhanced by any stimulus exposures that activate the sensitized circuit, regardless of whether those exposures occur while performing the target task. (3) Acquisition--the period of active practice-and consolidation are distinct phases of learning, each of which can be disrupted by intervening events. Our premise is that a greater understanding of the forces driving change and those promoting the status quo will help guide the development of more effective perceptual-training regimens for both clinical and non-clinical applications.

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3:10

The role of Auditory Backward Recognition Masking in natural listening conditions.

Richard E. Pastore
Jesse D. Flint
Brandon J. Bassile
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Auditory Backward Recognition Masking (ABRM) is interference in the recognition of some sound attribute due to the presentation of a subsequent sound. ABRM, studied in limited laboratory conditions, has been argued to reflect relatively minor interference in some probably early stage of pitch processing, and thus have limited relevance to complex sounds. Recently, Pastore, Gaston & Berens (2008) demonstrated that ABRM reflects interference in several general auditory processes important in the perception of simple and complex sounds. One major difference between natural and laboratory listening conditions is significant variability (uncertainty) in focal and contextual stimuli. As a major step towards moving from the laboratory to more natural listening situations, ABRM is measured identical contextual stimuli varied only across separate blocks of trials as well as within a single block of trials. Results suggest that, in natural listening conditions, ABRM may significantly limit the availability of sound information to the listener.

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3:30

Temporal weighting of auditory spatial cues

G Christopher Stecker
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Sound localization relies on multiple acoustic cues [interaural differences of time (ITD) and level (ILD), along with monaural spectral cues] that evolve over the durations of even brief stimuli. The informativeness of each cue similarly evolves, in a manner that reflects both the dynamic nature of the stimulus and its environmental context. Echoes and reverberation, for example, can act to reduce the informativeness of ongoing interaural cues while preserving cues at onset. Several lines of evidence suggest that the auditory system exploits this characteristic through uneven (and context-sensitive) weighting of onset and ongoing cues. Recent work from our lab explores how this weighting varies over the duration of brief (50-300) high-frequency sounds that contain multiple consistent or competing cues. In this presentation, we will describe some of this research, focusing especially on evidence for the importance of late-arriving cues in naturalistic localization tasks.

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3:50

Object-based Auditory Memory: The Assessment of Preparatory, Spatial and Temporal Constraints

Benjamin J. Dyson

Ryerson University

Five short experiments are described in which the ability to employ object-based organisation for the memory of complex auditory scenes is assessed. Experiment 1 establishes the basic effect in which participants are better at retrieving multiple pieces of information from the same object relative to different objects. Experiment 2 shows that although cueing the to-be-remembered attributes facilitates responding, it does not abolish the within-object advantage. Experiment 3 demonstrates no modulation of this effect as a result of introducing additional spatial variation between objects. Experiment 4 supports the short-term delay of object-based auditory memory and points towards auditory object-based inhibition of return. Experiment 5 rules out an association account of the data. While the issue of verbal recoding remains to be addressed, the data provide modest links between senses in terms of memorial organisation and suggests one account of how the multi-modal phenomenology of everyday life may be remembered.

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4:20

Towards Neurophysiological Correlates of Acoustic Short-Term Memory.

Christine Lefebvre
François Vachon
Stephan Grimault
Synthia Guimond
Robert Zatorre
Isabelle Peretz
Pierre Jolicoeur

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We sought to uncover neurophysiological activity related specifically to the maintenance of acoustic stimuli in short-term memory (STM) using the event-related potential (ERP) technique. The EEG was recorded while participants performed a same /different task on two non-musical tone sequences separated by a 2-sec retention interval. Memory load was manipulated by varying the number of tones in a sequence. The 2, 4, or 6 tones were preceded by white noise fillers to equal sequence length across trials. The voltages measured during the retention interval of this STM task were compared to those measured during completion of a control task. In this control task, participants ignored the first sequence and completed a judgement task on the second sequence. We observed an increase in negativity with memory load at frontal sites in the Memory task, but not in the Control task. These findings suggest that we can isolate electrical brain activity specifically related to the retention of pitch information in acoustic STM.

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4:40

Speaker normalization using cortical strip maps: A neural model for steady state vowel identification

Heather Ames

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Stephen Grossberg

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Auditory signals of speech are speaker-dependent, but representations of language meaning are speaker-independent. The transformation to speaker-independent language representations enables speech to be learned and understood from different speakers. A neural model is presented that performs speaker normalization to generate a pitch-independent representation of speech sounds, while preserving information about speaker identity. This speaker-invariant representation is categorized into unitized speech items, which input to sequential working memories whose distributed patterns can be categorized into syllable and word representations. The proposed circuits fit into an emerging theory of auditory streaming and speech categorization in which streaming and speaker normalization use similar neural designs; cortical strip map representations of auditory signals. Simulations with synthesized steady-state vowels achieve accuracy rates similar to those achieved by human listeners.

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5:00

Vowel Discrimination by English, French and Turkish Speakers: Evidence for an Exemplar-Based Approach to Speech Perception

Marc Ettlinger
Keith Johnson

Northwestern University
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Recent studies of speech perception have shown that speakers retain significant amounts of the phonetic detail of heard speech providing strong evidence for an exemplar-based model of the representation of speech sounds. This does not preclude the existence of a feature-based model as well, however, and indeed many theories of speech perception advocate a feature- or contrast- based model for the discrimination of speech sounds (e.g. Best et al., 2001). In this study, we provide evidence that an exemplar-based model of speech discrimination makes more accurate predictions based on the performance of English, French and Turkish speakers on a vowel perception task. The results also suggest that there are limitations on the effect of native language on speech discrimination depending on the task involved and the similarity of the sounds in question.

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Poster session 11:50 – 2:00

1

Congruent audiovisual dynamics facilitate perception of looming stimuli

Estella H. Liu
Barbara A. Church
Eduardo Mercado III

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University at Buffalo, The State University of New York

Successful exploration of the environment often involves evaluating and comparing information from multiple modalities. Previous research on audiovisual perception shows a strong biasing effect of vision over audition. One possible explanation for this asymmetrical integration is that vision dominates because this modality provides greater spatial resolution. In the current study, we showed that the congruency between two dynamic features of an audiovisual stimulus facilitates participants' ability to classify the stimulus. Listeners were asked to either categorize the direction of modulation of sound intensity, or to simply detect the presence of loudness change, while simultaneously seeing a disk either grow, shrink, or remain constant in size. Overall, the results showed that congruency between the two dynamic dimensions facilitated performance. This was true even in the detection task, for which the audiovisual congruence was irrelevant.

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2

Qualifying the Chills Response: Differences between Transient and Prolonged Chills in Response to Music

Valorie Salimpoor*
Mitchel Benovoy
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McGill University

Chills are highly pleasant physical sensations experienced to music and accompanied by heightened emotion and physiological arousal. We examined psychophysiological differences in response to "transient" chills and "prolonged" chills. Thirty-nine participants with varying musical backgrounds listened to self-selected music while psychophysiological recordings were collected. Results revealed that the majority of chills were prolonged, which were associated with higher ratings of pleasure and intensity, consistently experienced one week later, and almost always preceded by an increase in ratings of pleasure, representing a peak of the emotional experience to music. Transient chills were experienced as sudden and short burst of physiological responses, not always replicated upon repeated listening, and not as strongly associated with ratings of pleasure and intensity. There were distinct differences in heart rate, respiration, and skin conductance between transient and prolonged chills.

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3

Serial memory for lists of spoken words: The impact of distributing voices in space

Cindy Chamberland*
Catherine Mimeau
Sébastien Tremblay

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In serial memory, recall for lists of spoken words is better when words are spoken by a single talker than when they are spoken by multiple talkers – the talker-variability effect (e.g., Goldinger, Pisoni & Logan, 1991). We tested whether spatially distributing the stimuli can reduce the talker-variability effect. Within the serial recall paradigm lists of to-be-remembered digits were spoken either by a single or multiple talkers, at one or multiple spatial locations. Our results show that spatial distribution and talker-variability are additive. Rather than reduce the detrimental effect of talker-variability, distributing digits from multiple talkers further impaired serial recall. This pattern of results speaks to the close relationship between the perceptual analysis of the auditory scene and serial memory. Such findings also have practical implications for the design of multimedia interface and the use of spatialization for auditory alarms.

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4

Lexical salience and temporal dips: How does clear speech act as a masker?

Lauren Calandruccio*
Nah Eun Kim
Sumitrajit Dhar
Ann Bradlow

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Northwestern University
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It is well known that speaking clearly improves intelligibility for different listener groups [e.g., normal-hearing and hearing-impaired listeners (Picheny et al., 1985 and others)]. It is not well known, however, what happens when the competing speech is also spoken clearly. It's possible that clear speech would be a more effective masker than conversational speech due to greater overall intelligibility, providing more salient interference at the level of lexical access. However, it's also plausible that clear speech will be a less effective masker because listeners would be able to take advantage of the low-frequency modulations of the temporal envelope and listen "within the dips". To assess these hypotheses listeners' sentence recognition will be evaluated for clear and conversational speech using four masker conditions: 1-talker maskers spoken either clearly or conversationally, and temporally shaped 1-talker speech modulated noise maskers based on each of the two 1-talker maskers.

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5

Play It Again, Sam

Whitney Sims
Melissa Jungers*

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It is a commonly held belief that music can improve memory for information. The current study examined how presentation rate (fast, slow), mode (sung, spoken), and repetition effect recall. In Experiment 1, listeners heard sentences presented in one of four conditions (fast tempo-spoken, fast tempo-sung, slow tempo-spoken, slow tempo-sung) and then took a cued recall test filling in missing nouns. Results indicated that spoken sentences were better recalled than sung sentences, but there was no difference for presentation rate. In Experiment 2, the same set of sentences was heard twice. With the repetition, sung sentences were better recalled than spoken sentences and there was an effect of rate. The reversed effects of mode (sung, spoken) between the two experiments suggests that repetition may be a key factor in the use of music for memory.

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6

Does personality modulate interference in an auditory Stroop task?

Chris Tysiaczny*
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Todd Mondor

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The Stroop effect is a psychological phenomenon that illustrates that people are often unable to ignore word meaning even when it is irrelevant to the task of naming the colour of ink in which the word is printed. Leboe and Mondor (2007) reported an auditory version of the Stroop effect in which participants were unable to ignore one auditory dimension (e.g., pitch) when judging another (e.g., location). Tysiaczny and Mondor (2006) applied this auditory Stroop paradigm to emotional words and found that depressed people respond more slowly than non-depressed people when identifying the gender of the voice pronouncing depression-congruent words. The present study was designed to determine whether an auditory Stroop effect arises when people must name the gender of a voice speaking both narcissism-congruent and narcissism-incongruent words. Of particular interest was whether narcissists may respond more slowly than non-narcissists when identifying the gender of the voice pronouncing narcissism-congruent words.

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Limits on the number of concurrent auditory streams in arpeggiated tone sequences

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Two tasks assessed the nature of independent streams within rapidly arpeggiated sequences of sinusoids. Listeners determined how many distinct events they perceived in 10-plus-s sequences of 2-5 widely separated frequencies. Tone durations also varied across sequences (31.25-500 ms). Arpeggiated frequency patterns were cycled in either upward, up-down, or mixed directions. Preliminary results indicated that rapid sequences containing 4-5 frequencies were perceived as having only 3 streams. Anecdotal reports indicated that listeners segregated highest and lowest frequencies, with all others contributing to a complex middle stream. Perception of this stream was then assessed for a rapid 5-tone sequence by participants rating its similarity to various comparison events, including unaltered and faster tone sequences, the stream's center frequency, mixtures of all frequencies, and rising glides. Similarity was highest for tones that matched the interior of the sequence, indicating access to tones in the stream. Implications for stream segregation models will be discussed.

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Perception of sound source motion in a cluttered setting

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With regard to auditory spatial perception, most studies have made use of stationary sound sources. In real world settings, sound sources often move. It has also been the case that auditory perception studies have been conducted in empty (Euclidean) space. In real world settings, the environment is typically cluttered. The present study sought to determine the ability of observers to judge the location of a sound source that moved within a cluttered setting. In half the trials, the sound source stopped or passed an opening in a barrier. In the remaining trials, the target did not enter the opening. The task of participants was to report whether the target did/did not enter the opening in the barrier. In a follow-up experiment, perceptual judgments were considered with respect to the amount and type of information. Discussion will focus on the capability of individuals to gauge the movements of sound-producing objects.

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Is the observer an important variable in understanding auditory distance perception?

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It has been argued that perception is best understood when organism and environment are considered a single unit (Gibson, 1978). If true, perception is as much a function of the individual as it is the stimulus. The findings of a number of studies support this notion. In one study (Proffitt et al., 2003), half the participants judged distance while wearing a weighted backpack while half did not. Wearing a backpack was found to yield significantly greater distance judgments. With respect to the perception of distance by sound, the focus has been almost exclusively on the physical properties of the stimulus. To determine whether manipulations of the observer affect auditory distance judgments, participants in the present study were required to judge target distance while wearing or not wearing a weighted backpack. Discussion is given to the impact of observer manipulation and modality on spatial perception.

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Sound localization in noise: Why do people perform differently?

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Previous human studies report large inter-individual differences for sound localization in noise. A potential explanation for this variability could be the activity of the Medial Olivo-cochlear Efferent System (MOCS), which varies greatly between subjects (Backus and Guinan, 2007) and which has been assumed to help detection and localization of sound sources in noise (May, 2004). The present study examined whether individual differences in MOCS activity could account for individual differences in sound localization in noise. In a first experiment, we looked for correlation between performance in detection/localization of sound source in noise (diffuse field) at various signal/noise ratios, and MOCS activity measured by contralateral suppression of click evoked otoacoustic emissions. In a second experiment, we investigated the effects of sound localization training on individual differences of localization performance and of MOCS activity. Our preliminary results suggest that MOCS activity could be involved in the individual differences observed in sound localization in noise.

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Human psychophysics of spectral and temporal modulations and their interaction: A systematic approach to the processing of dynamic ripples

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This study assesses spectral, temporal and dynamic (spectro-temporal) modulation processing in the human brain. Spectro-temporal modulations are ethologically valid stimuli used for behavioral and neural responses in animals and humans before. The battery systematically tests detection and discrimination of spectral and temporal modulations, dynamic modulation detection, dynamic spectral and temporal discrimination, and difference ratings for dynamic modulation. Stimuli (100 components/octave; .25-4 kHz) have sinusoidal amplitude modulations over spectrum (density; .5-1.5 cycles/octave) and time (velocity; 4-16 cycles/second). Detection and discrimination tests are based on adaptive (2 down 1 up) procedures estimating 71% correct thresholds (for 2 rates with 50 trials each). Tests were run on 20 naïve subjects (30-79 years; 8 males). The data allow conclusive inference of spectral-temporal modulation processing based on correlation analysis (significance level, $p < .05$). Within tasks, thresholds were correlated between rates (densities or velocities), supporting tapping into the same process. Detection and discrimination of the same type of modulation were not correlated, suggesting that differentiation of rates depends not only on modulation sensitivity. No correlations were found between types of detection, implicating different (low level) mechanisms. Discrimination tests were in part correlated: purely temporal and dynamic velocity were correlated, purely spectral and dynamic density were not, but dynamic velocity and density were, suggesting that temporal and dynamic processing share a common neural basis. The findings are consistent with the existence and interaction of separable brain mechanisms for the processing of spectral, temporal and dynamic modulations that are typical of natural auditory events. The robustness of results encourages the use of these tests in assessing spectro-temporal processing in the disordered brain.

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Between-ear gap detection and the perception of dichotic continuity

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Gap detection is a commonly used measure of auditory temporal resolution. In its conventional, within-ear form, listeners detect a silent period ("gap") within a sound presented simultaneously to one or both ears. In an alternate, between-ear form, the leading and trailing gap markers are presented separately to the two ears. In the former task, gap thresholds are often < 2 ms. In the latter task, gap thresholds are often an order of magnitude higher. Here we describe several studies of between-ear gap detection conducted using two-alternative, forced-choice (2AFC) procedures. In separate studies, we investigated the conditions under which a sequential pair of sounds, split between the two ears, was judged to be continuous using a 1AFC procedure. We conclude that perceptual discontinuities occurring in situations where no temporal delay is present might, in the context of a 2AFC task, render the task one of gap discrimination, rather than gap detection.

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Relationship between Novel Music and Emotional Dimensions

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Music and emotion are inextricably intertwined, but little is known concerning how music evokes particular emotions in listeners. Music theory suggests musical elements including pitch, perceived tempo, harmonic mode, articulation, and loudness are thought to convey particular emotions. Some of these elements have been investigated in experiments that isolate single parameters, producing stimuli that are effective, but not “musical”. Other studies have used familiar musical stimuli, but these do not discriminate between memory-based mechanisms and perceptual mechanisms to explain the connection between music and emotion. To distinguish between these explanations we need a method that retains ecological validity by using real music, while at the same time decoupling memory for particular pieces of music from the perceptual stimulus. To that end, we developed and validated an algorithm that uses the above mentioned musical elements to generate novel musical stimuli that evoke intended emotions, measured via valence and arousal ratings.

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Vocal imitation of speech and song

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Two experiments investigated the role of phonetic information in the imitation of spoken sentences and sung melodies. In experiment one, subjects imitated sentences and melodies from recordings along with versions in which phonetic information was neutralized. Analyses of produced timing suggested that the imitation of sentences was facilitated by the presence of phonetic information, whereas phonetics did not influence melody imitation. Experiment two addressed the perceptual influence of phonetic information by having subjects imitate all stimuli using the neutral schwa. Here phonetic information in the stimulus disrupted the imitation of sentences and again did not influence melody imitation. These results suggest that phonetic and phonatory information are more tightly integrated during the imitation of speech than the imitation of song.

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The Role of Sparse Representation in Learning Musical Structure

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Evidence from visual perception suggests that sparse coding allows for a more efficient and effective way to distill structural information about the environment. Our simple recurrent network, MusNet, has shown this to be true of learning musical structure as well. After learning tonal relationships from several movements of J.S. Bach’s Suite No.1 for Unaccompanied Cello, MusNet then produced novel compositions based on various levels of training. The developmental trajectory of the network (from 500 to 5,000,000 epochs of training) was studied by examining sparseness of the hidden layer activations, and the sophistication of the network’s compositions. We found that increasing sparseness of the hidden layer activations strongly correlated with the increasing sophistication of MusNet’s output. Interestingly, sparseness was not programmed into the network, but rather emerged as an inherent property of learning the musical input. We argue that sparseness underlies the network’s success: it is the mechanism through which musical characteristics are learned and distilled, and facilitates the network’s ability to produce more complex and stylistic novel compositions.

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Duration as a cue to lexical identity in spoken word recognition

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Theories of spoken word recognition traditionally assume that lexical “lookup” takes place on abstract phonemic representations; this predicts that the spectral profiles of speech segments, but not their durations, should affect spoken word identification. We investigated the hypothesis that duration affects perceived word identity when speech segments exhibit a high degree of coarticulation, e.g., in casual speech. Experiment 1 investigated duration of vocalic portions of phonetically similar target phrases (e.g., “short” cease vs. “long” see us) spoken in semantically neutral context sentences; as expected, vocalic durations for “short” phrases were shorter than those of “long” phrases. In Experiment 2, durations of vocalic portions of target phrases in sentences from Experiment 1 were manipulated relative to sentential contexts using speech resynthesis techniques, thereby maintaining spectral profiles. Results showed that duration affected which words participants heard. These studies indicate that duration plays a significant and under-investigated role in spoken word recognition.

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Effects of Tempo on the Perceived Complexity of Auditory Rhythms

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Various factors influence listeners’ perceptions of the complexity of auditory rhythms, including stimulus properties and musical training. One stimulus factor that has not received much research attention is tempo. In this study, musicians and non-musicians heard twelve irregular auditory rhythms presented at five different tempi (ranging from fast to slow), which were rated on a six-point scale (1 – very simple, 6 – very complex). Each rhythm was rated twice, once during a block in which participants tapped the beat before making their rating, and once during a block in which participants simply listened before making a rating. Order of tapping and no tapping blocks was counterbalanced across participants. Rhythms heard at faster tempi were rated more complex than rhythms at slower tempi. In accordance with previous studies, tapping was found to increase perceived rhythmic complexity for both musicians and non-musicians.

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Informative tones receive enhanced processing: Electrophysiological evidence from the auditory P2 event-related potential

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To evaluate whether auditory processing is influenced by the temporal expectations ensuing from the context in which sounds are embedded, we examined event-related potential (ERPs) elicited during an auditory short-term memory task. On each trial, an auditory sequence composed of one, three, or five tones varying in pitch was presented before and after a 2-sec retention interval. Participants had to determine whether the two sequences were identical or not. To manipulate temporal uncertainty, the sequence length was either kept constant within each block of trials (predictable) or varied randomly from trial to trial (unpredictable). We observed enhanced P2 responses to ‘uncertain’ relative to ‘certain’ tones: When sequence length was unpredictable, the amplitude of the P2 component was larger for tones that provided information about forthcoming ones: the second tone of the 3-tone sequences and the second and fourth tones of the 5-tone sequences. No modulation of the P2 was observed when sequence length was perfectly predictable (blocked trials; or in the second sequence in each trial). These results suggest that tones that convey more information about the temporal structure of tone sequences receive more processing than less informative tones and that such effects take place relatively early in auditory processing.

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Effective Earcons for Use in Dual Tasks with Spoken Language
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A cross-modal dual attention experiment was completed by 198 undergraduates in 3 blocks that each consisted of an orientation task and a concurrent listening task. For the orientation task, participants located regions on an LCD that were cued by speech or one of 4 types of symbolic auditory cues (i.e., earcons); the concurrent task required participants to listen to and answer questions about GRE sample test passages. Results indicated the orientation task had no effect on comprehension of the passages compared to a passage-only control for 4 of the 5 auditory cue types. All auditory cues resulted in high performance for the orientation task, with speech and complex sounds exhibiting the highest performance. Implications for auditory display design and for assistive technologies for visually impaired persons will be presented.

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Factors mediating effects of rhythm context on duration-discrimination performance
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When listeners judge relative duration of standard-comparison pairs of time intervals preceded by a to-be-ignored context rhythm, judgments are more accurate when the tone marking the end of the standard interval is on-time relative to the context rhythm than when it is early or late. Entrainment models predict that this quadratic ('expectancy') profile should be reduced when the number of standards is increased. Previously, however, we found little support for this hypothesis. The present study extends this research by comparing performance under conditions of low and high trial-to-trial uncertainty about the tempo of the context rhythm and number of standard intervals. Increasing the number of standards improved performance when listeners were certain about the number of standards on each trial, but not when they were uncertain. However, no reduction in the expectancy profile was observed for either low or high uncertainty conditions. Implications for theories of timing will be discussed.

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Effectiveness of Changing Amplitude and Cue Validity On Aurally Cued Visual Search Performance
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In a visual search task in which two visual targets were cued by two audio signals, we found previously that targets cued with decreasing amplitude audio signals were located faster than targets cued with increasing or constant amplitude signals. This was surprising because of previously reported rising tone biases (e.g., Neuhoff, 2001). Here, we determined whether the benefit for decreasing amplitude tones in visual search can be found when a single target must be located. In the baseline condition, a single target and audio cue were presented. In the audio distractor condition, a single target was presented with two audio cues (one valid, one invalid). Audio cues were spatially coincident with the target when valid, and either increased, decreased or remained constant in amplitude. In the baseline condition, search latencies were unaffected by amplitude envelope. When a valid and invalid cue were presented (one changing amplitude and one constant amplitude), search times were fastest for changing amplitude cues.

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Relative contributions of spectral and temporal dimensions to the identification of musical instrument timbres

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Data from previous multi-dimensional scaling and discrimination studies have established relatively static spectral cues for musical timbre (e.g., spectral centroid, associated with brightness), as well as temporal cues (e.g., rise time). However, few studies have assessed instrument recognition salience. This paper describes two experiments which compare discrimination and identification for tones resynthesized from graded interpolations of spectral and temporal envelopes derived from two pitch- and loudness-matched data-reduced natural tones, a violin and a trombone. Experiment 1, based on spectral and temporal envelope interpolations, showed that listeners were most sensitive to spectral changes, while only extreme rise times impacted performance. Stimuli in Experiment 2 had fixed temporal (violin) envelopes, and included interpolated spectral envelopes, as well as low-pass filtered spectral envelopes that matched the interpolated envelope centroids while minimally impacting envelope shape. Listeners were much more sensitive to spectral envelope shape than to changes of spectral centroid. Implications will be discussed.

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Broadening the notion of cross-modal causality

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At APCAM 2007, we presented data suggesting a privileged relationship between impact gestures and their natural acoustic consequence - percussive sounds. Contrary to the optimal integration hypothesis, we found patterns of integration dictated not by information quality, but rather by the degree to which the visible gesture could have caused the audible sound. However, this work was limited to pairings of percussive sounds and impact gestures - non-percussive sounds paired with these same gestures failed to show the illusion. Here, we broaden that work by presenting different audio-visual pairings showing parallel patterns of cross-modal integration using non-percussive sounds and images. We paired the sound of a splash with a visual representation of the type of movement that could have caused a splash: a dot accelerating downward, then suddenly decelerating at a fairly constant rate (as if a falling object entered a body of water). Although these motions did not integrate with percussive sounds, they do integrate with and therefore influence judgments of splash sounds. These results broaden our previous work on privileged binding, and are consistent with the idea that causality is a key heuristic governing audio-visual integration.

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Developmental changes in liking for and identification of emotion in music

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We examined developmental changes in liking for and identification of emotions expressed by music. We presented the five most unambiguous happy, sad, scary, and peaceful sounding pieces from Vieillard et al. (2008) to 5-, 8-, and 11-year-olds. In the first part of the study, children rated how much they liked each of the 20 pieces. In the second part, they chose which of the four emotions they thought "went best with the music." Liking ratings decreased over development and were highest for pieces depicting high arousal emotions (happy and scary). Females and males tended to prefer positive and negative music, respectively. Accuracy improved with age and was best for music depicting high arousal emotions, while music depicting low arousal emotions (sad and peaceful) showed the most developmental improvement. Males were less accurate than females at younger ages but this gender difference disappeared by age 11.

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Perception of rapid speech in aging listeners
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Aging adults with sensorineural hearing loss have shown difficulties in understanding rapid (time-compressed) speech in previous studies (Gordon-Salant & FitzGibbons, 1993; Gordon-Salant & FitzGibbons, 2001). These difficulties have been attributed to reduction in abilities of elderly listeners to process duration of brief acoustic information in time-compressed speech (Dubno et. al., 1987; Gordon-Salant & FitzGibbons, 2001; Turner et. al., 1997). To date, no studies have investigated how audibility of rapid transitions influences the ability of aging listeners to process rapid (time-compressed) speech. In our study, we investigated perception of rapid speech by aging listeners under three rate conditions presented with- and without- audibility (amplification): 1) 0% Time Compressed (normal rate) Speech, 2) 30% Time Compressed (Rapid) Speech, and 3) 60% Time Compressed (Very Rapid) Speech. Results showed that significant differences exist between normal versus rapid speech conditions in aging listeners and significant differences between conditions with- and without- audibility.

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The Role of a Change Heuristic in Judgments of Sound Duration and Intensity
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In the current study, we investigated whether the quality of a frequency change within a sound (i.e., smooth vs. abrupt) would influence perception of its duration and intensity. In four experiments, participants were presented with two consecutive sounds on each of a series of trials and their task was to judge whether the second sound was either longer or shorter than the first, or louder or quieter than the first. In all experiments, we found that frequency change caused participants to misperceive sounds as both longer in duration and louder in intensity. These results demonstrate that the same irrelevant sound feature can provide the basis for multiple forms of illusion in the perception of auditory stimuli.

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A smile is just a smile: Audiovisual speech detection from an emoting face
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It is well established that visual speech can be used to improve comprehension of auditory speech in noise. The influence and potential utility of visual speech, however, may be reduced if the configuration of a face is altered. The current research investigated how facial configuration, altered by affective displays, might influence detection of audiovisual sentences presented in 12-talker babble. Participants were presented sentences with either a happy, sad, or neutral emotion and asked to repeat what they had heard. Results seemed to suggest that positive affect can enhance auditory speech perception more than neutral and sad faces. In addition, aspects of the actor's face were isolated and affective configurational distortions exaggerated, demonstrating the relative influence of affect to configural information for visual enhancement of speech in noise.

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Survival of the Fittest: Physical Fitness and Auditory Looming Perception

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Here we examined the relationship between physical fitness and the perception of looming auditory sounds. In this study, 40 participants were asked to estimate the arrival time of a three dimensional looming sound. Following this task, physical fitness was measured based on participants' recovering heart rate after exercise and on hand grip-strength. A significant positive correlation was found between heart rate recovery and an anticipatory bias in perceived arrival time of a looming sound. A significant negative correlation was found between strength and the looming bias. The results are discussed from an evolutionary standpoint, where the more physically fit a listener, the smaller the smaller the anticipatory looming bias required to avoid danger.

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