APCAM 2002

Auditory Perception, Cognition, and Action Meeting

Thursday November 21, 2002
The Westin Hotel
Kansas City, MO, USA

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Tucker-Davis Technologies

and

THE COLLEGE OF
WOOSTER

Welcome to APCAM 2002

I am pleased to welcome you to the very first Auditory Cognition, Perception, and Action Meeting. When I began to develop the idea for APCAM, I thought that if we attracted 20-25 participants and had enough presentations to fill an afternoon that the meeting could be considered successful. At the risk of declaring success before the meeting has actually started, I will simply note here that the program contains over thirty presentations and has over 70 participants from 13 different countries. I wish to thank all of you wished APCAM well in its inaugural meeting and offered advice and support as the meeting was being developed. I also would like to thank our keynote speaker Dr. Diana Deutsch, Tucker-Davis Technologies, and The College of Wooster. Finally, I encourage those of you who may be interested in helping to plan APCAM 2003 to get in touch with me. Enjoy your meeting!

Sincerely,

John G. Neuhoff
Chair, APCAM 2002

APCAM 2002 Schedule

8:00	**Registration**	
8:25	**Opening Remarks**	
8:30	Different Effects of Visual and Auditory Presentation on False Recognition Under Time Pressure	**Hwajin Yang** **Stephen J Ceci** **Sujin Yang**
8:50	Double-vowel Segregation based on a Cochleotopic/AMtopic Map using a Biological Neural Network	**Ramin Pichevar** **Jean Rouat**
9:10	Speech Perception as a Paradigmatic Case of Auditory Cognition	**Andrew J Lotto** **Lori L Holt**
9:30	**Break**	
9:45	Alignment to Moving Sound Sources	**Daniel H Ashmead** **Robert S Wall** **Wesley Grantham**
10:05	Auditory 'Looming' Perception in Rhesus Monkeys	**John G Neuhoff** **Asif A Ghazanfar** **Nikos K Logothetis**
10:25	An Ontological and Methodological Alternative to the Investigation of Auditory Space Perception	**Michael K Russell**
10:45	**Break**	
11:00	The Ecological Approach to Timbre	**André Oliveira** **Luis Oliveira**
11:20	Material Recovery from Real Impact Sounds	**Bruno L Giordano**
11:40	A Developmental Study of Auditory Scene Analysis	**Cecilia Garnier**
12:00	**Lunch**	
1:00	**Poster Session- 1:00-2:00 pm**	
2:15	**Keynote Address** **Two Relationships Between Music and Speech** **Diana Deutsch** University of California, San Diego	
2:45	**Break**	

3:00	The Development of Musical Interpretation: A Case Study	**Roger Chaffin** **Gabriela Imreh** **Anthony Lemieux** **Colleen Armitage**
3:20	Hearing the Past, Present, or Future During Music Performance	**Peter Q Pfordresher** **Caroline Palmer** **Grant Baldwin**
3:40	Does the Cognitive Representation of Melodic Interval Correspond to an Interval Scale?	**Timothy L Hubbard** **Jon R Courtney**
4:00	Effects of Pattern Structure on Auditory Perception	**Jennifer K Puente** **Mari Riess Jones**
4:20	**Break**	
4:30	Rate Limits in Sensorimotor Synchronization with Auditory and Visual Sequences	**Bruno H Repp**
4:50	Modeling effects of rhythmic context on the perceived timing of auditory events	**J Devin McAuley** **Mari R Jones**
5:10	Speeded Detection of Tones in Sequences: Effects of Temporal Structure	**Amandine Penel** **Mari R Jones**
5:30-6:30 Social Hour (Cash bar)		

	Posters	
1	The Contribution of Integral Processing of Frequency and Intensity to Auditory Scene Analysis	**Angelique A Scharine**
2	The Effect of Various Spatial Cues on Sequential Auditory Stream Segregation	**Susan E Boehnke** **Dennis P Phillips**
3	Auditory Saltation in Elevation	**Susan E Boehnke** **Susan E Hall** **Dennis P Phillips**
4	Distance Judgements Improve with Exposure to the Acoustic Environment	**Christopher A Brown** **William A Yost**
5	Directional Benefits of Audible Pedestrian Signals	**Robert S Wall** **Daniel H Ashmead** **Billie L Bentzen** **Janet Barlow**
6	Audiovisual Time-to-Arrival Judgments: Testing the Primacy of Multimodal Integration	**Michael S Gordon** **Lawrence D Rosenblum**
7	Auditory and Visual Cue Preference in Visual Search Performance	**Thomas Z Strybel** **Jason Lickel**
8	Usability Testing of Auditory Cues to Locate Regions on a Video Tablet	**Terri L Bonebright** **Dave Berque** **Seth Kinnett** **Nate Nichols** **Adam Peters**
9	Like Nails On a Chalkboard: Vision Erases an Aversive Auditory Stimulus	**Joseph F Wayand**
10	What confidence judgments reveal about the perception of the tritone paradox	**Magdalene H Chalikia** **Jyotsna Vaid**
11	What Words Come To Mind When Listening To Music	**Chris D Ayala** **J Devin McAuley**
12	Evidence That Consonance Reflects The Statistical Structure Of Human Vocalization	**David Schwartz** **Catherine Howe** **Dale Purves**
13	Pitch Perception Probes Cognitive Difficulties in Both the General & Learning Disabled Populations	**Karen Banai** **Merav Ahissar**
14	Neural Correlates of Auditory Perceptual Learning	**Eduardo Mercado III** **Itzel Orduña** **Jennifer F Linden** **Maneesh Sahani** **Mark A Gluck** **Michael M Merzenich**

8:30

Different Effects of Visual and Auditory Presentation on False Recognition Under Time Pressure

Hwajin Yang *Cornell University*
Stephen J. Ceci *Cornell University*
Sujin Yang *Cornell University*

The effects of modalities on false recognition were investigated using recognition time pressure and DRM paradigm. All experimental processes were controlled to avoid confounds. Visual and auditory lists in the study phase were systematically dispersed to minimize any contamination due to blocking. Presentation modalities were manipulated in four different study-test conditions (VV, VA, AV and AA). Multiple converging dependent variables were examined, including proportion of false recognitions, response times, and meta-memory judgments. In contrast to previous studies, congruent study-test modalities (VV, AA) led to significantly higher rates of false recognition under time pressure. Response time was significantly elongated only in auditory tests regardless of study modalities, suggesting auditory tests deterred subjects from establishing appropriate decision criteria for source monitoring. Furthermore, non-studied lures in auditory tests were accompanied by specific recollections of illusory details, as indicated by higher rates of "remember-judgments". These findings are discussed in terms of prevailing theories.

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8:50

Double-vowel Segregation based on a Cochleotopic/AMtopic Map using a Biological Neural Network

Ramin Pichevar *University of Sherbrooke and UQAC*
Jean Rouat *University of Sherbrooke*

We propose an auditory scene analyzer for double vowel segregation. Our technique is based on a two-dimensional representation of the signal that generates a cochletoptic/AMtopic map, which is used to mimic the periodicity analysis performed in the principal monaural pathway at the brain-stem level. In our scheme, the incoming signal is first processed by a cochlear filter bank and the AM modulation envelopes are extracted for the outputs of the bank. The FFT of the output of each channel is then computed. The two-dimensional representation we obtain this way is then applied to a network of biological neurons. We use three versions of the network: relaxation oscillator, chaotic, and integrate-and-fire networks. The biological neural map acts as a coherence detector, i.e., regions with different oscillation phases are formed based on the onset times of events belonging to different sources . These synchronized regions are used as masks for segregating sources.

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9:10

Speech Perception as a Paradigmatic Case of Auditory Cognition

Andrew J. Lotto *Washington State University*
Lori L. Holt *Carnegie Mellon University*

Traditionally, the perception of speech sounds has been described as a special process that is different in kind from general auditory cognition. This speech-is-special approach has robbed auditory cognitive science of an important theoretical testing ground. Just as text recognition has been essential to the development of visual cognitive science, the study of speech perception has the potential to significantly advance auditory cognitive science. Recent evidence suggests that much of the perception of speech can be explained by appealing to general processes of audition and learning. We will present data from new work on auditory category formation and statistical learning that demonstrates the proposed symbiosis between speech and general audition research. Results from categorization tasks using speech and non-speech sounds and human and animal subjects reveal patterns of responses that are consistent with computational models of learning and recent theoretical proposals from visual categorization.

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9:45

Alignment to Moving Sound Sources

Daniel H. Ashmead *Vanderbilt University*
Robert S. Wall *Vanderbilt University*
Wesley Grantham *Vanderbilt University*

Pedestrians with visual impairments rely on traffic sounds to align when crossing streets. We replicated studies showing alignment errors of ten degrees in real traffic settings. Further experiments in an anechoic chamber with a loudspeaker array, simulating sound source linear motion, suggest that the constraint on alignment to traffic lies in auditory motion perception. Listeners judged whether they were misaligned leftward or rightward with respect to the motion path, with the degree of misalignment varied psychophysically across trials. Variables included the portion of the motion path which was presented, velocity, and distance from listener at closest point of approach. Individual thresholds ranged from 5 to 18 degrees, with only small effects of the independent variables. These findings add to previous reports that auditory motion perception is rather crude, and implicate spatial hearing as a major constraint for blind pedestrians.

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10:05

Auditory Looming Perception in Rhesus Monkeys

John G. Neuhoff *The College of Wooster*
Asif A. Ghazanfar *Max Planck Institute for Biological Cybernetics*
Nikos K. Logothetis *Max Planck Institute for Biological Cybernetics*

Intensity change is a salient cue to approaching and receding sound source motion, and humans often overestimate the change of rising, compared to falling intensity tones. Similarly, auditory "looming" studies show an underestimation of time-to-contact for approaching sound sources. These results have been interpreted in terms of their potential evolutionary benefits because they provide a "margin of safety" in preparing for looming objects. Here we provide converging evidence for this evolutionary hypothesis. Using rhesus monkeys, we measured the duration of a head turn toward a hidden loudspeaker that produced either rising or falling intensity sounds. Subjects oriented over twice as long to "looming" tones than to "receding" tones. As in humans, the bias occurred for harmonic tones (which can reliably indicate single sources), but not for broadband noise. Our results demonstrate a bias for looming sounds that is consistent with an evolved neural mechanism that processes approaching objects with priority.

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10:25

An ontological and methodological alternative to the investigation of auditory space perception

Michael K. Russell *Washburn University*

Investigations into auditory space perception tend to adhere to a particular methodology. For example, stimuli tend to be simple sounds and are broadcast in anechoic settings. Furthermore, observers are often posturally limited and required to make verbal judgments using an Euclidean metric (feet, meters, etc.). The purpose of this talk will be to present an alternative to the traditional manner in which auditory space perception is conducted. The alternative to be proposed is based, in part, on James J. Gibson's ecological approach to visual perception. Auditory perception investigations adhering to a Gibsonian, ecological approach have shown observers to be both highly accurate and highly consistent in their perceptual judgments. Examples of an ecological approach to auditory distance and location perception will be presented.

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11:00

The Ecological Approach to Timbre

André Oliveira *Maringa State University*
Luis Oliveira *Paulista State University*

The objective of this paper is to postulate that the ecological approach to auditory perception can bring a new perspective to the description and analysis of music and sound parameters, especially the timbre that the traditional psychophysics perspective has offered . We begin by the discussion of the traditional approach to timbre, as developed in acoustic and psychoacoustic areas. After that, we bring a new conception of timbre based on ecological approach to perception. In this sense, are quite important to show concepts such wave front and wave train, beside the notions of invariant, affordance and meaningful sounds to characterize our understanding of an ecological perspective of timbre. Finally, we believe that ecological approach to perception has been used to provide a rich conceptual basis for the description and analysis of the ecological parameters of sound.

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11:20

Material Recovery from Real Impact Sounds

Bruno L. Giordano *University of Padua*

Three experiments were performed in order to assess the ability of listeners to recover the material of the objects from non-synthetic sounds. Stimuli were produced percussing damped and freely vibrating plates of different areas and made of four different materials (iron, glass, wood and plastic). Results show that recovery of material is far from perfect, as it is significantly influenced by extraneous features of the sound source, namely the area of the plates. Furthermore, certain types of material discrimination reveal opposite response profiles in different subjects. Experimental results are modeled using two sets of variables: the ones describing the sound source, and the ones describing the acoustical signal. A few hypotheses are finally presented, relating material recovery to previous experience and to its evolutionary importance, compared to that of hardness detection.

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11:40

A Developmental Study of Auditory Scene Analysis

Cecilia Garnier *University of Burgundy*

In this study, we examined the development of auditory scene analysis in human listeners. Three groups of subjects (7, 11 year-olds and adults) were presented with auditory scene containing an increasing number of environmental sound sources (from 2 to 6). In a detection task, listeners had to detect a specific sound target (e.g. the barking of a dog). In a counting task, they had to report how many streams they heard in the scene. We expected performance in both tasks to decrease with complexity of the scene but to increase with age. Results showed that an increase in the number of concomitant sound sources moderately decreased performance in the detection task but strongly affected performance in the counting task. More precisely, adults never reported hearing more than five streams, children not more than four.

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2:15

Keynote Address: Two Relationships Between Music and Speech

Diana Deutsch *University of California, San Diego*

Two sets of findings relating music to speech are described. The first involves the tritone paradox - a two-note pattern that has some curious properties: For any one listener, the pattern is heard as ascending when played in one key, but as descending when played in a different key. Furthermore, when played in any one key, the pattern is heard as ascending by some listeners but as descending by others. It has been shown that perception of this illusion varies with the geographic region in which the listener had grown up, and with the language or dialect to which he or she has been exposed. Recent work has demonstrated that speech heard in early childhood is a particularly strong determinant of how this pattern is perceived, even for adults who no longer speak this language fluently. It is concluded that a speech-related template that is acquired early in life has a powerful influence on perception of this musical illusion. The second set of findings concerns absolute pitch - the ability to name or produce a note of particular pitch in the absence of a reference note. This ability is generally assumed to be extremely rare. However, a recent study has found that native speakers of two tone languages (Mandarin and Vietnamese) display an extraordinarily precise form of absolute pitch in enunciating words. The subjects in this study had received little or no musical training, and it is concluded that their ability resulted from the early acquisition of tone language, so that they had learned to associate pitches with meaningful words very early in life. From these and other findings it is proposed that absolute pitch, which has traditionally been regarded as a musical faculty, originally evolved to subserve speech

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3:00

The Development of Musical Interpretation: A Case Study

Roger Chaffin *University of Connecticut*
Gabriela Imreh *No institutional affiliation*
Anthony Lemieux *University of Connecticut*
Colleen Armitage *University of Connecticut*

The practice of a concert pianist was recorded as she learned the third movement of J.S. Bach's Italian Concerto (Presto). Tempo variation during practice performances was assessed by measuring inter-bar-intervals (IBI). Multiple regression related IBI in the polished performance to features of the music such as section and phrase boundaries and melodic contours to identify the interpretive gestures of the performance. The same predictor variables, representing the interpretive gestures, were then used in additional regression analyses of practice performances from different sessions across the learning process. Comparing practice performances at different points in the learning process allowed identification of the point at which each gesture first appeared and how regularly it reappeared in subsequent practice performances. The procedure provides an empirical analysis of the development of musical interpretation.

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3:20

Hearing the Past, Present, or Future During Music Performance

Peter Q. Pfordresher *The University of Texas at San Antonio*
Caroline Palmer *The Ohio State University*
Grant Baldwin *The Ohio State University*

Many studies document disruption of performance (including speech and music) when auditory feedback is delayed. Explanations of this phenomenon often rely on the fact that feedback contents (e.g., pitches, phonemes) occur later than expected (e.g. MacKay, 1987). However, researchers have not examined performances in which feedback contents match events intended for the future. We report studies in which the pitch contents of auditory feedback were manipulated during piano performances to match events from earlier or later in the sequence, relative to the current event. Both early and late feedback manipulations caused similar overall disruption. Serial ordering errors in performance demonstrated suppression of event repetition during normal feedback conditions, consistent with post-output suppression; suppression was reduced when past or future events were heard. Overall, results suggest that hearing future events disrupts performance as much as past events; specifically, feedback alterations diminish performers' ability to suppress recently produced events.

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3:40

Does the Cognitive Representation of Melodic Interval Correspond to an Interval Scale?

Timothy L. Hubbard *Texas Christian University*
Jon R. Courtney *Texas Christian University*

Listeners heard sequential target and probe melodic intervals and judged whether probe intervals were the same size as target intervals. Experiment 1 presented a series of equally spaced nonmusical intervals; memory for the size of small intervals was displaced toward a larger interval size, and the magnitude of this displacement decreased with increases in interval size. Experiments 2 and 3 presented a series of musical intervals. When target and probe intervals moved in the same direction, there were trends for memory for smaller intervals to be displaced toward a larger interval size; when target and probe intervals moved in opposite directions, there were no consistent trends in displacement. The data are partially consistent with Burns and Ward's (1982) suggestion that representation of musical scale is compressed for small intervals and expanded for large intervals, and suggest that the cognitive presentation of musical interval may not correspond to an interval scale.

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4:00

Effects of Pattern Structure on Auditory Perception

Jennifer K. Puente *The Ohio State University*
Mari Riess Jones *The Ohio State University*

Participants heard recurrent 9-tone novel melodies with varied pitch interval structure (large versus small semitone intervals). The first two of three presentations of a melody contained an embedded target tone that varied systematically in target pitch distance (small, large) from the melody. A probe tone (higher, same or lower than the target pitch) replaced the target in the third presentation. Listeners' task was to identify the pitch change of the probe (i.e. respond "higher," "same," or "lower"). Across different experiments, rate (fast, slow) and relative probe timing (early, on-time, late) were also varied. Previous research, using several different judgment tasks, suggests that attentional deployment depends on listeners' expectancies about a pattern's structure. This study illustrates that such expectancies include reliance on both pitch and time relationships. These appear to guide attending and to systematically affect accuracy levels in a pitch judgment task.

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4:30

Rate Limits in Sensorimotor Synchronization with Auditory and Visual Sequences

Bruno H. Repp *Haskins Laboratories*

In-phase synchronization of finger taps with events in an isochronous sequence becomes difficult when the event rate exceeds a certain limit. This synchronization threshold is reached at rates of 8-10 Hz in audition (tone sequences; 1:4 tapping), but at rates as slow as 2.5 Hz in vision (flash sequences; 1:1 tapping). At slower rates, a reduction in tap timing variability occurs when the intervals between synchronization target events are subdivided by additional identical events (1:n tapping), compared to no subdivision. This subdivision benefit decreases and turns into a cost as the event rate approaches the synchronization threshold. The synchronization threshold and the loss of the subdivision benefit represent two different, but probably related, modality-specific temporal processing limits. The results demonstrate the superiority of the auditory over the visual modality in activities requiring rhythmic coordination.

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4:50

Modeling effects of rhythmic context on the perceived timing of auditory events

J. Devin McAuley *Bowling Green State University*
Mari R. Jones *The Ohio State University*

In this talk, we describe a general theoretical framework for modeling effects of rhythmic context on the perceived timing of auditory events. A series of experiments evaluated this framework by manipulating the timing of tone onsets that defined two time intervals (a standard and a comparison) embedded within a rhythmic context sequence; tones onsets marking the beginning and ending times of to-be-judged time intervals were on time, early, and late, relative to the implied rhythm of the context. In all experiments, relative judgments about the duration of the comparison interval showed an overall expectancy profile in accuracy with best performance found when the standard ended on time and poorest when it was early or late; much weaker, but significant effects were found for variations in beginning times. These findings are discussed within the context of the best-fitting quantitative model derived from the proposed theoretical framework.

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5:10

Speeded Detection of Tones in Sequences: Effects of Temporal Structure

Amandine Penel *The Ohio State University*
Mari R. Jones *The Ohio State University*

Music and speech are temporally structured. One reason is probably that temporal regularities enable predictions about when an event will occur, and perhaps to focus attention to expected points in time. We undertook a series of experiments examining the effects of temporal structure on speeded detection. Is a tone which occurs on-time detected faster or slower than one which occurs early or late? Following sequences of between N = 4 and 8 identical high-pitched short tones, target tones (three semi-tones lower) were presented at various randomized temporal positions (e.g., for a sequence with a 500 msec IOI, targets were presented between 300 and 900 msec after the last inductive tone). Participants pressed a button as fast as possible as soon as they detected the target. Results suggest slower reaction times for on-time targets, whether N is randomized or blocked.

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Poster session 1:00-2:00

1

The Contribution of Integral Processing of Frequency and Intensity to Auditory Scene Analysis

Angelique A. Scharine *HRED, Army Research Lab, Aberdeen, MD*

It has been demonstrated previously that continuous changes in a tone's intensity can interact with its frequency producing significant changes in its perceived pitch (Neuhoff & McBeath, 2002). Changing frequency has a similar effect on the perception of intensity. Presuming that it would not be adaptive to "lose" or ignore the component dimensional information, this research examines the possible function of this integral processing. It is proposed that this integral relationship provides a perceptual regularity that is used to facilitate the parsing of meaningful patterns in the auditory scene. Here we show that tones presented with a noisy background have a lower threshold when their change in frequency is "consistent" with intensity, that is, when both are moving in the same direction. The threshold is also shown to be lower for "consistent" rising than falling intensity tones, but a reverse pattern was observed for "inconsistent" tones.

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2

The Effect of Various Spatial Cues on Sequential Auditory Stream Segregation

Susan E. Boehnke *Dalhousie University*
Dennis P. Phillips *Dalhousie University*

It is well known that differences in frequency, pitch, ear, or timbre promote segregation of two interleaved sounds in sequential stream segregation experiments, but little is known of the effectiveness of auditory spatial location cues. In experiment 1, subjects rated their perceptual experience (integrated or segregated) of a repeating A_B_A__ sequence of identical wideband noise bursts, where A differed from B in either ear of presentation (EAR), interaural level difference (ILD) or interaural time difference (ITD). In experiment 2, detection thresholds were obtained for a temporal asymmetry in each type of ABA sequence, a task that is impaired when A & B form separate streams. Separation of A and B by EAR was most effective in generating separate streams, and in impairing temporal asymmetry detection performance relative to a diotic control. While stream formation by ITD was possible, it was weak and did not impair performance on the temporal asymmetry task.

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3

Auditory Saltation in Elevation

Susan E. Boehnke *Dalhousie University*
Susan E. Hall *Dalhousie University*
Dennis P. Phillips *Dalhousie University*

Auditory saltation is a misperception of the location of sounds presented in short, periodic trains. Saltation was studied in elevation, where location is specified by monaural spectral cues. In 'real' motion trials, each click in an 8-click train came from the next in a vertical array of speakers; in 'saltation' trials, the first and last halves of the click train came from the top and bottom speakers respectively. Subjects performed 3 tasks: 1) The perceived motion continuity of click trains varying in inter-click interval, direction and motion type ('saltation' vs 'real') was rated on a 5-pt scale 2) The same stimuli were labeled as 'saltation' or 'real'; 3) The threshold ICI at which 'saltation' and 'real' motion could be discriminated was determined using a 2AFC staircase procedure. 'Saltation' stimuli in elevation supported a robust motion illusion; 'saltation' was indistinguishable from 'real' motion at click rates above 10 Hz.

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4

Distance Judgements Improve with Exposure to the Acoustic Environment

Christopher A. Brown *Parmly Hearing Institute, Loyola University Chicago*
William A. Yost *Parmly Hearing Institute, Loyola University Chicago*

To determine whether exposure to an acoustic environment can help a listener make distance judgements, 5-ms broadband noise bursts were played and recorded through a KEMAR manikin from distances of between 4 and 9 feet in a reverberant room. A loudspeaker sat atop a table, and was moved to each distance prior to recording. During testing, the stimuli were presented over headphones to listeners seated in a sound-attenuating chamber. Data show that listeners perform as well in this condition as when seated in the room. In condition 1, KEMAR remained in the room with the mic amps on and the signal mixed with the stimuli, so that listeners were exposed to the ambient sound of the room between trials. In condition 2, no signal was added. Performance in condition 1 was significantly better than in condition 2, indicating that exposure to the acoustic environment can enhance auditory distance perception.

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5

Directional Benefits of Audible Pedestrian Signals

Robert S. Wall *Vanderbilt University*
Daniel H. Ashmead *Vanderbilt University*
Billie L. Bentzen *Boston College*
Janet Barlow *Boston College*

Audible pedestrian signals are sometimes provided to inform pedestrians with visual impairments when the walk interval is in effect. Typically, these signals come simultaneously from both ends of the crosswalk (even from two parallel crosswalks), limiting their usefulness as directional beacons. In three experiments with blind and blindfolded sighted participants, various signal characteristics were explored, using simulated crosswalks and prerecorded ambient traffic noise. Pedestrian crossings had lower directional errors when the signal was presented only from the far end of the crosswalk than when it was presented from both ends either simultaneously or alternately. Errors were also lower when one rather than two crosswalks were signaled, even though participants said they couldn't hear the second crosswalk signals. Our research team participates in policy committees for U.S. federal standards on pedestrian signals, which will be described briefly in this presentation.

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6

Audiovisual Time-to-Arrival Judgments: Testing the Primacy of Multimodal Integration

Michael S. Gordon *University of Toronto at Mississauga*
Lawrence D. Rosenblum *University of California, Riverside*

This research examined anticipatory perception of an approaching vehicle that varied in the modality of presentation. Within each approach presentation, the audio and visual media were periodically made available or unavailable. For 'intermittent' presentations, the audio and visual media were presented together. At 500 ms intervals, the presentation was turned on or off. For 'alternating' presentations, the media were alternated between acoustic and visual at 500ms intervals. Normal, intact audiovisual presentations were also tested. Alternating and intact presentations supported equal judgment accuracy, and better than for the intermittent presentations. These results seem to suggest that the continuity of the event, rather than the continuity of the individual modalities, was most salient for TTA perception. Results are discussed in terms of theories of information integration.

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7

Auditory and Visual Cue Preference in Visual Search Performance

Thomas Z. Strybel *California State University Long Beach*
Jason Lickel *California State University Long Beach*

We examined the effectiveness of auditory and visual cues in visual search performance. Participants located and identified two targets (one in each hemifield) in a large, cluttered search field. Both targets were cued and three cue conditions were tested: two auditory cues (pulsed noise varying in pulse rate); two visual cues (large and small square); and one auditory and one visual cue. The targets were presented at 15, 27 and 39 deg. The percentage of trials on which a participant identified a cued target first was used to measure cue effectiveness. With two visual cues, the closer target was usually identified first, regardless of cue size. With two auditory cues, neither distance nor pulse rate determined cue preference. When one visual and one auditory cue were presented, the visual cue was responded to first at 16 and 27 deg. At 39 deg., the auditory cue was preferred when it was closer.

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8

Usability Testing of Auditory Cues to Locate Regions on a Video Tablet

Terri L. Bonebright *DePauw University*
Dave Berque *DePauw University*
Seth Kinnett *DePauw University*
Nate Nichols *DePauw University*
Adam Peters *DePauw University*

This study is part of a larger project designing a video tablet for low vision students to use in the classroom for material that would normally be placed on a blackboard. The usability test was designed to determine which of two types of sounds (tones or numbers) would work best to designate 9 positions on a video tablet. 36 normal vision students participated and performed two tasks simultaneously. One task required them to click on the appropriate position on the screen after a sound was played, while the second task required them to listen to a passage and answer questions about its content at the end of a set of 36 sound trials. The results showed that the participants in the number condition showed fewer errors and faster reaction times; however, there was no difference in the comprehension of the passages between the two conditions Email: tbone@depauw.edu

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9

Like Nails On a Chalkboard: Vision Erases an Aversive Auditory Stimulus

Joseph F. Wayand *DePauw University*

Visual capture is a well-known phenomenon: what we see can influence perceptions in another modality. The influence can be quite strong and convincing, as anyone who has seen a ventriloquist can attest. The present study uses an aversive auditory stimulus to test the boundaries of visual capture. Participants viewed a film vignette featuring either a person scraping his nails on a chalkboard or a crying eagle in flight, and were asked to rate the pleasantness of the sound heard in each vignette. The soundtracks were swapped for half of the participants. Results indicated the visual component of the vignettes strongly influenced ratings of the sounds. Listeners who watched the eagle film but heard the chalkboard sound rated the sound as pleasant. Less dramatic examples of visual capture may take place in everyday situations, and designers of devices involving both visual and auditory displays should be aware of these effects.

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10

What confidence judgments reveal about the perception of the tritone paradox

Magdalene H. Chalikia *Minnesota State University Moorhead*
Jyotsna Vaid *Texas A&M University*

The tritone paradox consists of two octave-complex sounds that are separated from each other by a half-octave (tritone) interval (Deutch, 1986). These are presented successively and the listener decides whether or not the pattern is perceived as ascending or descending in pitch. Different listeners can perceive the same pattern differently, hence the paradox. Perception of the tritone stimuli varies with geographical location and language background. The present study tested monolingual and English/Spanish late bilinguals in Texas. In addition, listeners? confidence in making the perceptual decisions was examined in order to determine differences, if any, in ascending and descending judgments. Fisher exact probability tests indicated that the peak pitch class distributions of the two groups were not different, in contrast with earlier findings that had reported differences (Chalikia & Vaid, 1999a; 199b). Confidence ratings and possible reasons for the discrepancy between these and earlier results will be discussed.

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11

What Words Come To Mind When Listening To Music

Chris D. Ayala *Bowling Green State University*
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Previous studies have shown that in episodic recognition paradigms, familiar melodies are better remembered than novel melodies. It is unclear whether this occurs because familiar melodies are better learned than novel melodies or because they have more consistent verbal labels, which leverage memory retrieval. As an initial investigation of this issue, a normative study was conducted that asked participants to listen to a set of eighty melodies, and write down the first two words that came to mind. For each melody, we calculated the number of word associates (set size) and the strength of each associate. Highly familiar melodies (based on listeners' ratings) were found to vary considerably in set size (from small to large) and the strength of the primary associate (from weak to strong). Relative novel melodies, in contrast, had very few consistent associates, and those that were elicited often described abstract properties of the melodies or emotions.

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Evidence That Consonance Reflects The Statistical Structure Of Human Vocalization

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Listeners of all ages and societies produce a similar consonance ordering of chromatic scale tone combinations. Despite attempts to explain the phenomenon dating back at least to Pythagoras, there remains no generally accepted scientific explanation for this musical universal. Working from the assumption that conspecifc vocalizations are the primary source of the periodic sound energy to which humans are exposed, we obtained normalized spectra from >100,000 recorded speech segments. The statistical spectrum of human speech (i.e., mean normalized amplitude as a function of normalized frequency) predicts both the frequency ratios that define the chromatic scale intervals and the consonance ordering of chromatic scale tone combinations. This evidence indicates that consonance judgments are wholly determined by the relative likelihood of the different possible sources of tone-evoking stimuli.

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Pitch Perception Probes Cognitive Difficulties in Both the General & Learning Disabled Populations

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Previously we found strong correlations between frequency discrimination (JNDs) and "higher-level" cognitive abilities among both reading disabled (RD) and normally reading adults. In this study, we screened two junior high-school classes, a regular one, and a special class for individuals who need additional extracurricular academic support. Replicating the adult findings, we found that RDs in both classes (10% and 50% in the regular and special class, respectively) had the highest JNDs (>30%) and the poorest verbal memory. Dividing the special class according to frequency JNDs, we found that those with the highest JNDs (67% on average) were also the poorest readers, had the weakest phonological awareness, and had particularly poor verbal memory. On the other hand, their performance in face memory and block assembly was only marginally impaired. This profile is characteristic of learning disability (LD). We propose that frequency discrimination may serve as a powerful screening tool for LDs.

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Neural Correlates of Auditory Perceptual Learning

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Auditory discrimination training improves animals' abilities to differentiate the sounds experienced during training. To investigate the role of cortical representations in this process, we trained rats to discriminate broadband, frequency-modulated sounds in an operant, two-choice discrimination task. Rats readily learned to discriminate these complex acoustic events, and proved to be able to generalize learned discriminations to novel sounds. Following training, extracellular recordings of auditory cortical neurons were collected from trained and naive rats under barbiturate anesthesia. We found that the similarity of spike trains evoked by two complex sounds corresponds closely to the difficulty rats have discriminating those two sounds, and that auditory receptive fields were more likely to be spectrotemporally inseparable in trained rats than in naive rats. These findings show that learning modulates cortical sensitivities to complex sounds, and that perceptual sensitivities to complex acoustic stimuli can be predicted from the neural responses evoked by those sounds.

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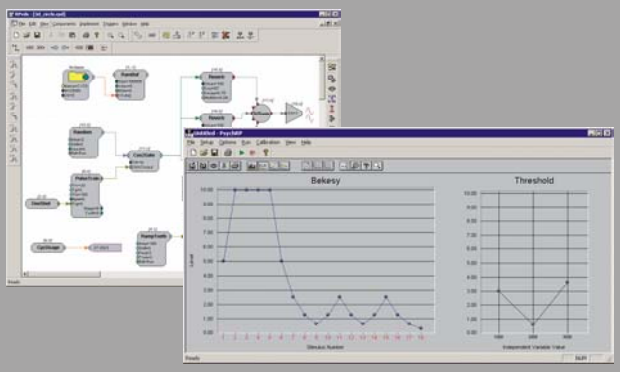

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