APCAM 2010

9th Annual Auditory Perception, Cognition, and Action Meeting

Thursday November 18

Millennium Hotel

St. Louis, MO, USA

Program sponsored by

WASHBURN UNIVERSITY

Welcome to APCAM 2010

We are pleased to welcome you to the eighth 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 The College of Wooster and Washburn University. Enjoy your meeting!

Sincerely,

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

APCAM 2010 Schedule		
8:00	**Registration – Field Room**	
8:30	**Opening Remarks**	
	Auditory Perception (abstracts pages 7 – 8)	
8:40	Using nonlinear stimulus-frequency OAEs (nSFOAEs) to study auditory attention	**Kyle P. Walsh* Edward G. Pasanen Dennis McFadden**
9:00	Echolocation strategies adopted by flying bats evaluated with an onboard wireless microphone system	**Hiroshi Riquimaroux***
9:20	***Invited presentation: Tribute to Ira Hirsh***	**William Clarke**
9:40	**Break (20 min)**	
	Speech Perception (abstracts pages 8 – 9)	
10:00	Nonspeech rate information influences speech perception, but proximity counts.	**James T. Mantell* James R. Sawusch**
10:20	Who I am, what I say, and how I say it: The effects of talker variability on affective language.	**Jennifer M. Roche* Caitlin S. Mills Erica Booker Rick Dale**
10:40	There goes the neighborhood: Lipreading and the structure of the mental lexicon	**Julia Feld* Mitchell Sommers**
	Poster Session (11:00 – 12:30 PM) South Exhibit Hall Abstracts located on pages 14 – 24	
	Lunch (12:30 – 1:20 PM)	

Perception and Action (abstracts pages 10 – 11)		
1:20	LATTE- Linguistic Auditory Threat Test Effect. Can Listeners Monitor for Phonemes and Ignore the Threat Presented by a Spoken Word	**Boaz M. Ben-David* Pascal H.M.M. van Lieshout Nicole A. Durham Namita Multani**
1:40	Facial expressions in song and speech	**Steven R. Livingstone* Caroline Palmer Marcelo Wanderley William F. Thompson**
2:00	Can musicians track two different meters simultaneously?	**Ève Poudrier* Bruno H. Repp**
2:20	Action is more accessible than material	**Guillaume Lemaitre* Laurie M. Heller**
2:40	**Break (20 min)**	
Music Learning and Expertise (abstracts pages 12 – 13)		
3:00	Musical Expertise and Rhythmic Variability in "Two Note Tunes"	**John Neuhoff Colleen Bartman Brandon Pool**
3:20	Learning mechanisms for acquiring knowledge of tonality in music	**Matthew Rosenthal* Rikka Quam Erin Hannon**
3:40	Generating a Geno? -- An Old-Fashioned Neural Network Approach to a Cajun and Creole Chord Change Conundrum	**Roxanne B. Raine* Istvan S. N. Berkeley**
4:00	**Closing Remarks**	

Posters (abstracts located on pages 14 – 24)		
1	Paths for Rehabilitation of Communication Skills following Traumatic Brain Injury: Do Negative Emotions Impede Identification of Emotion in Speech for TBI Patients?	Boaz M. Ben-David* Nicole A. Durham Pascal H.M.M. van Lieshout Namita Multani
2	A basis for perceptual interactions between timbre and pitch	Michael D. Hall Christopher Becker
3	Attention, predictibility and the auditory 'oddball' effect in perceived duration.	Alan Wedd* Molly J. Henry J. Devin McAuley
4	Deafness to changes in chords	Kathrin Lange* Robert Schnürch Carina Kreitz Martin Heil
5	Adults' and Children's Classification of Speech and Music Sequences on the Basis of Culture-specific Rhythm	Sangeeta Ullal* Erin E. Hannon
6	Effects of Context on Serial-Ordering Errors in Music Performance	Brian Mathias* Caroline Palmer Peter Q. Pfordresher Maxwell Anderson
7	Developmental change in spatial release from informational masking	Doris J. Kistler Frederic L. Wightman Amanda F. O'Bryan*
8	The effects of identity and location on on-line temporal bisection in the auditory domain	Benjamin J. Dyson Rajwant Sandhu*
9	Differentiating Rock from Bach, Identification of Mainstream Recordings Requires Only Brief Excerpts	Jay Dowling* Shannon Layman
10	Neuronal mechanisms underlying retention of timbre in acoustic short-term memory.	Synthia Guimond* Christine Lefebvre Patrick Bermudez Pierre Jolicoeur
11	The Effects of an Auditory Spatial Location Cue and of Response Repetition	Philippe Audette* Todd Mondor
12	Action verbs are the most accessible level of sound event description	Guillaume Lemaitre* Laurie M. Heller
13	Research into the influence of a system of pitch and rhythm patterns on the promotion of aural attention abilities of elementary school pupils	Valdis Bernhofs* Ilma Grauzdina

14	**Practicing with Auditory Graphs: Do Graph and Question Complexity Impact Comprehension?**	**Terri L. Bonebright* Michael A. Nees**
15	**Quantifying the segmentation of auditory necklaces**	**Minhong Yu* Michael Kubovy**
16	**Is the world the same size when I use my ears as when as I use my eyes? A test of James J. Gibson's notion of the partial equivalence of perceptual systems.**	**Michael K. Russell***
17	**The influence of mood on the detection threshold for pure tones**	**Anne Bolders***
18	**The Effects of Approaching and Receding Sounds on the Perception of Terminal Distance**	**Ethan Wohl* Michael F. Neelon**
19	**Auditory Model Designed from Principles of Survival**	**John K. Bates***
20	**Computational approach oriented by the Gestalt perceptual theory**	**Bruno Giesteira***
21	**The effect of motion resolution on the auditory motion aftereffect**	**Michael F. Neelon***

8:40

Using nonlinear stimulus-frequency OAEs (nSFOAEs) to study auditory attention

Kyle P. Walsh* *University of Texas at Austin*
Edward G. Pasanen *University of Texas at Austin*
Dennis McFadden *University of Texas at Austin*

The possibility that selective auditory attention can affect the processing characteristics of the cochlea via the medial olivocochlear (MOC) pathway was investigated in human listeners using a nonlinear version of the stimulus-frequency otoacoustic emission (SFOAE), called the nSFOAE (Walsh et al., 2010). The nSFOAE stimulus was a long-duration tone (4.0 kHz, 200 ms) presented simultaneously to the two ears, either in quiet (tone-alone) or in noise (tone-plus-noise), and the nSFOAE response was extracted using a cancellation procedure. The test stimulus consisted of a sequence of seven randomly-selected spoken digits that was interleaved with a sequence of six nSFOAE stimuli. The speaker was female in one ear and male in the other, and the ear that received the female speaker alternated across trials. The task of the listener was to attend to the female voice, to memorize the spoken digit string, and then to match a subset of the digit string to one of two choices presented visually on a computer screen. When nSFOAEs were measured during periods of selective attention, the tone-plus-noise responses exhibited larger maximum magnitudes, and larger deviations from the tone-alone magnitudes, compared to the responses measured during a no-attention condition, in which the competing speech streams were presented, but with no forced-choice behavioral task. The difference in the maximum magnitudes across these two conditions was about 4 – 5 dB, on average. These results suggested an enhancement of MOC inhibition during selective auditory attention. In addition, the time course of these observed attentional effects appeared to be substantially longer than the time course of the passive MOC reflex. An advantage of these measures is that the behavioral and physiological responses are recorded concurrently, offering a unique look at information from the periphery that may be available for making perceptual decisions. [Supported by NIDCD.]

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9:00

Echolocation strategies adopted by flying bats evaluated with an onboard wireless microphone system

Hiroshi Riquimaroux* *Doshisha University*

Echolocating bats listen to returning echoes from a target to get different types of information related to the target. However, they have various targets that they have to pay attention to. Some targets are fixed but some are moving. How a bat listens to these echoes is not clear until acoustic characteristics of echoes are recorded through a wireless onboard microphone, Telemike, carried by the bat. Varieties of experiments have been conducted on bats with a Telemike in the laboratory. Some of evidences revealed with Telemike recordings are shown here. Doppler-shift compensation, which had been exhibited on a pendulum with restrained bats, was confirmed with freely flying bats. Namely, the bats controlled emitted pulse frequencies so that Doppler-shifted frequency of returning echoes would be constant. Echo amplitude compensation was also first shown with flying bats, where the amplitude of emitted pulses was adjusted so that the amplitude of returning echoes would be constant. Time-sharing signal processing appeared to be used for getting information from multiple targets. How the bats are intercepting an insect and how they deal with jammed situations created by neighboring conspecifics will be discussed by analyzing their biosonar signals recorded through Telemike. [Research supported by ONR grant]

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9:20

Invited presentation: Tribute to Ira Hirsh

William Clarke *Washington University in St. Louis*

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10:00

Nonspeech rate information influences speech perception, but proximity counts.

James T. Mantell* *University at Buffalo, The State University of New York*
James R. Sawusch *University at Buffalo, The State University of New York*

Previous work has shown that speaking rate of speech can influence perception of individual phonetic segments such that listeners normalize to the context rate (Kidd, 1989; Sawusch and Newman, 2000). Additionally, nonspeech rate information, in the form of temporal and frequency varying tone precursors, has been shown to influence the perception of a stop - glide phonetic contrast in a highly stylized synthetic speech continuum (/ba/ - /wa/; Wade & Holt, 2005), such that faster tone precursors led to more glide [w] identifications than stop [b] identifications. The current work further investigates these phenomena. In experiment 1, 1200ms precursors composed of either fast or slow tones were used with a naturally spoken /got/ - /kot/ series presenting a voiced - voiceless contrast. Fast tones led to more voiceless [k] identifications than voiced [g] identifications, replicating and extending previous results. Experiments 2-5 investigated the temporal locus of the nonspeech influence by adjusting the temporal properties of the nonspeech precursors. These nonspeech precursors were composed of fast, slow, and/or intermediate duration tones and varied in rate but not absolute duration. Furthermore, the precursors were manipulated so that the fast and slow tones occurred close to or far from the target syllable. Overall, the results strongly suggested that the influence of nonspeech rate information is greatest for tones that are temporally proximal to the speech target. In other words, only target-local nonspeech precursors appear to be driving rate-induced changes in the perception of phonetic segments. However, distal influences of speech rate have previously been identified (Summerfield, 1981; Kidd, 1989). Taken together, these and previous results are concordant with the view that speech perception is partly mediated by a general auditory, durational contrast mechanism.

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10:20

Who I am, what I say, and how I say it: The effects of talker variability on affective language.

Jennifer M. Roche* *The University of Memphis*
Caitlin S. Mills *The University of Memphis*
Erica Booker *Jackson State University*
Rick Dale *The University of Memphis*

Nygaard and Lunders (2002) have shown that affective prosody impacts the resolution of lexical ambiguity during spoken language, yet social factors and sentential meaning are often excluded (Snedeker, 2008). Language, prosodic variation and social cues to affective speech are essential for successful interpretation of intent (Attardo, Eisterhold, Hay & Pogi, 2005). The Own Race Bias suggests that members of a particular race tend to recognize information from their own race better than those of others (Meissner & Brigham, 2001). The current study evaluates the perception of intent from ten spoken neutral sentences in four affective expressions (Compassion, Innuendo, Irritation, and Neutral) by two female talkers (African-American and Caucasian). It was predicted that participants should more accurately perceive intent from their own race. Twenty-eight participants (12 African-American, 11 Caucasian & 5 Other; 21 females; mean age: 21) listened and judged intent behind the speakers' statements. A discriminant function analysis was used and showed there were specific acoustic cues that significantly separated the affective expressions between the two speakers. A mixed fixed/random effects model was used to evaluate the proportion of target intent responses. Results suggested that listeners have the ability to perceive intent behind statements above chance. The Caucasian female's statements were easiest to interpret, overall ($p < .001$). Compassion was the hardest affective expression for participants to interpret ($p < .001$), especially by the African-American female talker ($p < .001$). There was an effect of learning; accuracy increased significantly for all affective expressions over time (at least $p < .01$). Though only two speakers were used, we argue that these results do not support the Own Race Bias, but do support the view that affective prosody plays a large role in the interpretation of sentential meaning, regardless of the race of the individual perceiving it.

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10:40

There goes the neighborhood: Lipreading and the structure of the mental lexicon

Julia Feld* *Washington University in St. Louis*
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Although spoken word recognition is generally thought of as an auditory phenomenon, speech may also be perceived visually, through observation of the speaker's articulators, including the lips, tongue, teeth, and face. Research in the auditory domain has demonstrated that spoken word identification is influenced by the lexical properties of the stimulus word, including the frequency with which it occurs and the extent to which it is perceptually similar to other words in the lexicon (Luce & Pisoni, 1988; McClelland & Elman, 1986). Following this work, several studies have explored whether lexical properties influence word identification similarly in visually perceived (lipread) speech (Auer, 2002; Mattys et al., 2002; Tye-Murray et al., 2007). The current research evaluated metrics for quantifying the influence of the mental lexicon on visually perceived spoken word recognition using metrics that are well-established in the literature, as well as a novel statistical method for calculating perceptual confusability, based on the Phi-square statistic. The Phi-square statistic proved an effective measure for assessing lexical competition and explained significant variance in lipread word identification beyond that accounted for by traditional metrics. Because values based on Phi-square include the influence of many words in the lexicon (rather than only perceptually very similar words), it suggests that even perceptually distant words may receive some activation, and therefore provide competition, during spoken word recognition. These findings extend the scope of activation-competition models of spoken word recognition and reinforce that the perceptual and lexical properties underlying spoken word recognition are not specific to the auditory domain.

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1:20

LATTE- Linguistic Auditory Threat Test Effect. Can Listeners Monitor for Phonemes and Ignore the Threat Presented by a Spoken Word

Boaz M. Ben-David* *University of Toronto*
Pascal H.M.M. van Lieshout *University of Toronto*
Nicole A. Durham *University of Toronto*
Namita Multani *University of Toronto*

Introduction: Can people focus on an attribute of the stimulus when another attribute is laden with emotion or directly threatening? There is substantial literature concerned with this question employing mainly the paradigm known as the emotional Stroop task (ES, Algom, Chajut & Lev, 2004). However, to date, research has been limited to assessing threat-related effects in written words. In this study, we devised an auditory equivalent to the ES, the Linguistic Auditory Threat Test Effect (LATTE), testing listeners' ability to monitor for the presence of a target phoneme while ignoring the threat presented by the spoken word. Methods: Healthy native English speakers are asked to monitor for specific phonemes, while listening to spoken words. Approximately half the trials have a target phoneme present, and the other half do not. One block consists of threat words (e.g., RAPE) and the other of neutral words (e.g., CHAIR). An advantage in latency for the neutral block (= LATTE) will show that listeners are not able to selectively attend to the sound of the words, while ignoring the content of words. A matched performance on both blocks will show listeners' immunity to semantic threat in auditory speech. Preliminary findings: We were able to replicate the ES in the auditory domain. Average response latencies in the threat block were longer than in the neutral block, in both target-present and target-absent trials. Implications: Preliminary data suggest that listeners cannot avoid the threat-content of spoken words. This threat appears to take a toll on their performance. We believe that researchers should take into account the emotional content of the spoken stimuli they are using. Further research is needed to evaluate the sources of this threat effect and its impact on communication skills with both healthy and pathological populations.

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1:40

Facial expressions in song and speech

Steven R. Livingstone* *McGill University*
Caroline Palmer *McGill University*
Marcelo Wanderley *McGill University*
William F. Thompson *Macquarie University*

Although facial expressions are an integral part of emotional communication in speech and song, few studies have examined how facial gestures encode specific emotional states in speech and song. We examined the time course of facial expressions during the production of speech and song. Participants spoke or sang short statements with five emotional intensities (neutral, happy, very happy, sad, and very sad). Motion capture techniques recorded facial movements during three time stages, determined by the acoustic recording: prior to production (planning phase), during production, and post- production. Three primary facial features were examined: lip corners, eyebrows, and lower-lip movements. Overall, the pattern of motion across speech and song was similar for a given emotional content. Facial features differed, however, during vocal production with larger lower-lip movements in song than in speech. Within each vocal method, eyebrow and lip-corner movements changed in intensity with the emotional state during planning, production and post-production, with extreme positions held longer during post-production. These results suggest that facial expressions carry emotional information during and following vocal production. Facial movements unique to the production stage (not in planning or post-production stages) suggest that speech and song entail different facial movements for production, but similar movements for emotional communication.

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2:00

Can musicians track two different meters simultaneously?

Ève Poudrier* *Yale University*
Bruno H. Repp *Haskins Laboratories*

The simultaneous presence of conflicting metrical structures is not uncommon in western art music and the music of various non-western cultures. However, it is unclear how listeners and performers deal with this situation, and whether it is possible to cognitively establish and maintain simultaneous conflicting meters. The present study is a first attempt to address this issue empirically. Two rhythms, distinguished by pitch register and representing different meters (2/4 and 6/8), were presented simultaneously in various phase relationships, and participants (who were classically trained musicians) had to judge whether a probe tone fell on the beat in one or the other rhythm. In a selective attention condition, they had to attend to one rhythm and to ignore the other, whereas in a divided attention condition, they had to attend to both. Participants performed significantly better in the divided attention condition than predicted by the null hypothesis that they would be able to attend to only one meter at a time. Although it is difficult to conclusively rule out integrative strategies that circumvented truly polymetric perception in our task, the results do show that it is possible to track two different meters simultaneously, which suggests that some form of parallel processing might be at play.

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2:20

Action is more accessible than material

Guillaume Lemaitre* *Carnegie Mellon University*
Laurie M. Heller *Carnegie Mellon University*

Human listeners are able to recover causal properties of sound events: both the actions that caused the sounds, and the objects on which the actions were executed. Whereas many studies have focused on the listeners' ability to recover the properties of the objects (and in particular: the material), comparatively few have studied the actions that caused the sounds. Here we report a study comparing the performance of listeners required to listen to sounds and identify either the actions or the materials of the objects by which they were generated. We used a set of pipes of different sizes and materials (wood, plastic, glass, metal) on which we performed different actions (scraping, rolling, hitting, bouncing), which were specifically chosen so that we could systematically cross action and material. In a first experiment, we tested how well listeners thought each sound conveyed that it was made by a different action or material (or combination of both). In a second experiment, we then measured the accuracy and reaction times of different sets of listeners required to identify which action, material, or combination of action and material had caused very brief excerpts of these sounds (we also varied sound duration). The results clearly showed that listeners were faster and more accurate at identifying the action compared to identifying the material. Even for those sounds that were equally good at conveying both their causal action and material, listeners were faster and better at identifying the action than the material. These results suggest that the auditory system is better suited to extract information related to the action generating the sounds.

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3:00

Musical Expertise and Rhythmic Variability in "Two Note Tunes"

John Neuhoff *The College of Wooster*
Colleen Bartman *The College of Wooster*
Brandon Pool *The College of Wooster*

Differences in music perception and performance between expert and novice musicians are well established. These differences typically emerge in tasks that tap the highly developed musical cognitive structure present in experts and lacking in novices. Previous work on rhythmic variability has shown that novice musicians produce musical rhythms that are related to their perception of rhythm in their native language and that this rhythmic production can be altered when they are instructed to "compose a tune in another language". Here we examined the relationship between musical expertise and the rhythmic variability of novel melodies spontaneously produced by both experts and novices. Participants were asked to use only two keys on a piano keyboard to create novel "two note tunes". The tunes were analyzed for rhythmic variability using the Normalized Pairwise Variability Index. We found a significant positive correlation between level of expertise and rhythmic variability. The results are discussed in the context of recent work demonstrating cognitive links between rhythmic production in music and language.

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3:20

Learning mechanisms for acquiring knowledge of tonality in music

Matthew Rosenthal* *University of Nevada Las Vegas*
Rikka Quam *University of Nevada Las Vegas*
Erin Hannon *University of Nevada Las Vegas*

Experienced listeners possess a working knowledge of pitch structure in Western music, such as scale, key, harmony, and tonality, but this knowledge develops gradually throughout childhood. It is commonly assumed that tonal representations are acquired through exposure to the statistics of music. Nevertheless, potential learning mechanisms have rarely been investigated directly (c.f. Creel & Newport, 2002). Tonally stable pitches not only have a higher overall frequency-of-occurrence, but they may occur more frequently at strong than weak metrical positions, providing another potential avenue for tonal learning. Two experiments employed an artificial grammar-learning paradigm to examine tonal learning mechanisms. During a familiarization phase, we exposed listeners to a long (whole-tone scale) sequence with certain distributional properties. In a subsequent test phase we examined listeners' learning using grammaticality or probe tone judgments. In the former task, participants indicated which of two short test sequences conformed to the familiarization sequence. In the probe tone task, participants provided fit ratings for individual probe tones following short "reminder" sequences. Experiment 1 examined learning from overall frequency-of-occurrence. Grammaticality judgments were significantly above chance (Exp. 1a), and probe tone ratings were robustly predicted by frequency of occurrence (Exp. 1b). In Experiment 2 we presented a familiarization sequence containing one sub-set of tones that occurred more frequently on strong than on weak metrical positions and another sub-set that did the opposite. Overall frequency-of-occurrence was balanced for both sub-sets. Grammaticality judgments were again above chance (Exp. 2a) and data thus far suggest that probe tone ratings are higher for tones occurring on strong metrical positions. These findings highlight two types of distributional cues that may allow learners to acquire knowledge of tonality in Western music.

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3:40

Generating a Geno? -- An Old-Fashioned Neural Network Approach to a Cajun and Creole Chord Change Conundrum

Roxanne B. Raine* *University of Memphis*
Istvan S. N. Berkeley *University of Louisiana at Lafayette*

Cajun melodies often have a very simple chord structure, with as few as two chords. Nonetheless, Cajun musicians have difficulty articulating the cognitive process underlying their ability to know when to change chords. For example, before beginning our study, we interviewed five Grammy nominees, all of whom basically said they "just knew" when to change chords in playing Cajun music. As is common in many highly routinized human behaviors, it appears that expert Cajun musicians do not have explicit access to the implementation process behind their procedural actions once they have become sufficiently routine behaviors. To explore possible algorithms behind chord-change detection, we trained a multi-layer perceptron using backpropagation to correctly simulate changing the chords for the Cajun melody 'Bayou Pon Pon.' Manipulations of the amount of the melody that the network was exposed to had a significant and drastic effect upon performance. When our network with 6 bits of note information could not reach convergence, we added one more note to the inputs. Giving this additional information to the network resulted in network convergence with an error rate below .001, a substantial and impressive change from the previous trial. A post-training network analysis revealed that the network had discovered a 'rule,' which was recoverable to solve the problem.

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Poster session 11:00 – 12:30: South Exhibit Hall

1

Paths for Rehabilitation of Communication Skills following Traumatic Brain Injury: Do Negative Emotions Impede Identification of Emotion in Speech for TBI Patients?

Boaz M. Ben-David* *University of Toronto*
Nicole A. Durham *University of Toronto*
Pascal H.M.M. van Lieshout *University of Toronto*
Namita Multani *University of Toronto*

Introduction: Traumatic Brain Injury (TBI) has devastating cognitive, motor and social consequences. Difficulty in identifying emotions in speech (EID) has been found to have a detrimental impact on the quality of life of TBI patients (e.g., Zupan & al., 2009). Henry et al., (2006) asserted that "assessing and treating the emotional processing deficits associated with TBI should be seen as an urgent priority…rehabilitation efforts should be focused on remediation of this specific deficit." (p. 68). One factor of EID may relate to the emotional threat evoked by certain spoken words. We present the basis for an ongoing study, directed at unveiling possible sources of EID in spoken language for TBI patients. Mainly, we are testing whether threat-related effects in language can impede patients' ability to detect emotions in speech. Methods: TBI patients and healthy control participants are compared on a variety of tests: A) self-reports on EID; B) Emotional Rating of Speech, evaluating the accuracy of identification of emotions in speech; C) LATTE – Linguistic Auditory Threat Test Effect, evaluating the ability of listeners to monitor for phonemes, while ignoring the threat presented by spoken words. D) Emotional Stroop, evaluating the ability of participants to name the font color of print words, while ignoring the threat presented by the content of printed words. Hypothesis: A linkage between behavioral and/or self reports on EID and tests on threat-related effects can reveal a novel path for rehabilitation of communication skills in TBI patients. Mainly, if the threat content of speech is related to EID, this threat-related effect can be targeted in both rehabilitation interventions, and as best-practice guide-lines to care-givers (e.g., which type of speech should be avoided).

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2

A basis for perceptual interactions between timbre and pitch

Michael D. Hall* *James Madison University*
Christopher Becker *James Madison University*

Several demonstrations reveal individual differences in pitch as a function of spectral changes in timbre, including the pitch of the missing fundamental (Seither-Preisler, Johnson, Seither and Lütkenhöner, 2007) and the tritone paradox (Repp, 1997). Two experiments were conducted to evaluate whether some listeners frequently mistake changes in perceived brightness, presumably in response to changes in spectral centroid, for changes in pitch.
In both experiments listeners judged whether pitch descended, remained the same, or ascended across pairs of tones that included a standard pitch, A_4, and a comparison pitch (A_4, $A^{\#}_4$, or F_5). In Experiment 1 listeners responded to tones with a static spectral envelope derived from a violin. In Experiment 2 the same listeners responded to Shepard tones (from Deutsch's 1995 CD) that have been used in tritone paradox evaluations (e.g., Deutsch, 1987). In addition to a *no-change* (standard-only) condition, there were two *timbre-change* conditions. One contained a spectral centroid shift produced by either a missing fundamental (Exp. 1) or a shift in spectral envelope (Exp. 2); in the other condition comparison timbres were low-pass filtered to match the standard's spectral centroid. *Pitch-change* trials (p=0.5) were accompanied by either congruent (different centroid) or incongruent (same centroid) timbre changes (p=0.5). Across experiments, timbre manipulations produced significant shifts in the accuracy of pitch judgments, and filtered tones were generally judged more like standard stimuli (except for same-pitch comparisons in Exp. 1, where filtering had a detrimental effect by exaggerating spectral differences). Furthermore, significant correlations were found between the degree to which pitch judgments were affected by timbre and the duration of musical training. Collectively, these findings indicate that listeners differ in the extent to which pitch is influenced by the distribution of energy across frequencies and suggest that pitch-matching performance might be improved by initially eliminating spectral differences in timbre across stimuli.

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3

Attention, predictibility and the auditory 'oddball' effect in perceived duration.

Alan Wedd* *Michigan State University*
Molly J. Henry *Bowling Green University*
J. Devin McAuley *Michigan State University*

When an unexpected (oddball) stimulus is presented within a series of otherwise identical auditory or visual (standard) stimuli, the duration of the oddball tends to be overestimated. Explanations of the oddball effect have proposed that subjective lengthening of the oddball is due to increased attention to the unexpected stimulus (Tse et al., 2004) or conversely, to decreased attention to the predictable stimulus (repetition suppression) (Pariyadath & Eagleman, 2007). Critically, both explanations predict that the oddball duration should always be overestimated relative to the standard duration. The present study tested both possibilities by having listeners judge the duration of an oddball frequency sweep embedded in a nine-sweep series, where the oddball differed from the standard in terms of frequency velocity. The standard sweep always had a velocity equal to 1000 Hz/s and absolute duration of 500 ms; for one group of participants the oddball velocity was 500 Hz/s, and for another group of participants the oddball velocity was 1500 Hz/s. The serial position of the oddball varied randomly from trial to trial across positions 5, 6, 7, or 8 and took on duration values that ranged from 300 ms to 700 ms in 50-ms steps. Listeners judged whether the oddball duration was 'shorter' or 'longer' than the standard. When the oddball velocity was faster than the standard (1500 Hz/s), the oddball duration was overestimated. However, when the oddball velocity was slower than the standard (500 Hz/s), the oddball duration was underestimated. Results are inconsistent with both the enhanced attention and repetition suppression hypotheses, but rather support the view that duration judgments about auditory stimuli reflect systematic interactions between the pitch and time characteristics of the stimuli. Findings are more generally consistent with the view that intrinsic features of stimuli determine the nature of subjective duration distortions (van Wassenhove et al., 2008).

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4

Deafness to changes in chords

Kathrin Lange* *Heinrich Heine Universität, Düsseldorf*
Robert Schnürch *Heinrich Heine Universität, Düsseldorf*
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Martin Heil *Heinrich Heine Universität, Düsseldorf*

Change blindness refers to the phenomenon that a huge change in a visual scene remains undetected when a visual disruption (e.g. a blank screen) is inserted at the moment of the change. Whereas change-blindness is well investigated, only few studies have addressed a possible auditory analogue, change deafness, so far. Most of these studies used naturalistic sounds, which changed over time. The present study used chords in order to make the task similar to the visual 'flicker' task, where participants have to detect a change in an otherwise static visual scene. In each trial, participants listened to three chords (duration of each chord: 3000 ms). The first and the last chord were always identical, but the second chord differed in half of the trials by one tone. In the control condition, the chords were played continuously. In the experimental conditions, chords were disrupted by a pause, which was either silent or filled with white noise. The duration of the pause was 100 ms, 1000 ms, 2000 ms, or 3000 ms. The participants were asked to indicate after each trial, if all chords were identical or not. As expected, the change was easily detected when the chords were presented continuously. In all experimental conditions, however, substantial change deafness with respect to the control condition was observed. The size of the change deafness effect did not differ between conditions with silent and filled pauses. However, change deafness increased with increasing duration of the pause. Whether the change deafness effect is due to trace decay from auditory short term memory, to the masking of the local transient that draws attention to the change, or to some other mechanism remains to be investigated.

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Adults' and Children's Classification of Speech and Music Sequences on the Basis of Culture-specific Rhythm

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Speech prosody of a language and the songs of its culture exhibit striking similarities. For example, stress-timed languages like English have greater rhythmic contrast than syllable-timed languages like French. Likewise, instrumental music from England has higher note-to-note rhythmic contrast than music from France. Adults trained to classify instrumental songs or low-pass filtered speech utterances on the basis of rhythm (into French or English classes) can accurately classify novel sequences from the same domain. Even though such within-domain classification has been demonstrated for both speech and songs, the extent to which classification skills rely on domain-specific or domain-general representations of rhythm remains unclear. In this study, we investigated whether rhythmic representations are domain-general or domain-specific by examining classification within and across domains, under the assumption that domain-general representations should allow listeners to generalize across domains, whereas domain-specific representations should limit generalization to within-domain stimuli. We examined potential developmental changes by testing adults and children. Adults (N=40), and children aged 5 (N=33) and 8 (N=33) were trained to classify low-pass filtered speech utterances or instrumental songs as "Davi" or "Latu" (corresponding to English and French). The generalization phase consisted of two blocks during which participants classified novel songs and novel utterances. Older children and adults accurately classified novel stimuli when the test domain matched the training domain (i.e. within-domain generalization) but classification of stimuli across domain was at chance. Younger children performed similarly within and across domains but their performance was not above chance in either domain. These results suggest that despite the fact the music and speech share rhythmic properties, rhythmic representations appear to be domain-specific by the age of 8.

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Effects of Context on Serial-Ordering Errors in Music Performance

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We investigated the effect of short and long contexts on memory retrieval of musical events during performance. Skilled pianists practiced two-hand isochronous musical sequences until they achieved an error-free performance, and subsequently performed the sequences at fast tempi chosen to elicit performance errors, the dependent measure indicative of sequential planning. Identical musical excerpts composed of 8 events were embedded in two contexts: short (4 events preceding and 4 following) or long (12 events preceding and 12 following). We were interested in how the length of the surrounding context influenced retrieval of the excerpt. Pitch error rates decreased across practice, demonstrating learning. Error rates were higher in the excerpt produced at the faster tempo than the moderate tempo, consistent with speed-accuracy tradeoffs. An interaction between context and tempo was observed: Long contexts enhanced the effect of tempo on error rates in the excerpt, relative to short contexts. Serial-ordering errors tended to arise from greater distances at moderate tempi than at faster tempi, and in excerpts placed in longer contexts than in shorter contexts. Fits of the data with a contextual model of sequence planning (Palmer & Pfordresher, 2003) showed that errors tended to arise from metrically similar events more often in long contexts than in short contexts. These findings provide evidence that longer contexts facilitate sequence production by strengthening associations among sequential elements.

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Developmental change in spatial release from informational masking

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Informational masking is a form of auditory masking which occurs in part because of similarity of target and masker. Reducing similarity, such as through spatial separation of target and masker, produces a release from informational masking in adults. Arbogast, Mason, & Kidd, (2002, 2005) found substantial spatial release (~15 dB) from informational masking in adults using the Coordinate Response Measure (CRM) stimuli, processed so as to minimize energetic masking and maximize informational masking. We used their paradigm to investigate spatial release from informational masking in 38 children, ages 6-18, and 34 adults, ages 19-61. The CRM consists of messages of the form; "Ready [call sign] go to [color] [number] now." Participants were required to respond with the color and number spoken by the talker with the call sign "Baron." Both signal and masker messages from the CRM corpus were processed by extracting the envelopes of 15 narrow frequency bands and using the envelopes to modulate carrier tones at the center of each band. On each trial the target speech was generated by adding 8 randomly chosen bands and the masker was generated by adding the remaining 7 bands. Two conditions were tested in a semi-anechoic room: 1) co-located target and masker presented at 0˚ azimuth, (2) target presented at 0˚ azimuth and masker presented at 90˚ to left. Speech reception thresholds (target-masker ratio at 51% correct) were estimated from fitted psychometric functions for each participant in each condition. Spatial release was defined as the difference between the masked thresholds in the co-located and spatially separated conditions. Individual differences in spatial release were large. Adults showed a 7-26 dB benefit of spatial separation, while children younger than 10 years received little to none. For the children, the amount of benefit from spatial separation of target and masker increased with age.

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The effects of identity and location on on-line temporal bisection in the auditory domain

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A novel paradigm is introduced in which participants performed on-line temporal bisection in the auditory domain. At each trial, participants were provided with two consecutive presentations of a sound of identical length. During the first presentation, participants simply estimated the duration of the sound. During the second presentation, participants pressed a key in the middle of the sound as it was being replayed: essentially cutting the sound in two to indicate its perceptual centre. In Experiment 1 within a given trial, sounds could have either flat or changing (increasing, decreasing) pitch during the first presentation and have either flat or changing (increasing, decreasing) pitch during the second presentation. The data revealed that the nature of sound identity influenced on-line temporal bisection, consistent with previous research. In Experiment 2, visual and auditory spatial attention was static or redirected (leftward or rightward) across first and second presentations within a given trial. The data revealed some modulation in on-line temporal bisection as a function of spatial shifts. Analogies are discussed between auditory and visual pseudoneglect, as are the implications of the spatial representation of time in sound.

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Differentiating Rock from Bach, Identification of Mainstream Recordings Requires Only Brief Excerpts

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We tested listeners' ability to identify 500-msec excerpts from the beginnings of recordings of mainstream songs. Previous studies have shown that subjects can recognize familiar tunes well above chance in as little as 200-msec. These studies were limited by the small number of stimuli and the presence of a list of the songs during the experiment. We sought to extend the previous findings by using a broader and more selective range of stimuli than those used previously and also provide electrophysiological data in order to more closely differentiate the temporal processing of the familiar and unfamiliar stimuli. Our stimuli were drawn from a survey of 400 familiar songs of multiple genres that was distributed to a diverse panel of undergraduate students from the University of Texas at Dallas. Students made judgments of familiarity on a scale from 1 (not familiar) to 7 (extremely familiar) and we chose 56 of the songs with the highest familiarity ratings as our stimuli in our behavioral experiment and added 56 more highly familiar songs to our electrophysiological experiment. The number of unfamiliar stimuli was balanced for both experiments respectively. The results of the behavioral study showed that participants were able to recognize a wide range of complex stimuli in the form of popular songs well above chance in an extremely limited amount of time. More importantly, participants were actually much better at being able to dismiss songs that do not contain meaningful information, quickly as well. The electrophysiological data provided converging evidence to previous studies that the familiar stimuli placed greater demand on cognitive resources of attention and memory shown by a more negative N5 peak as opposed to the unfamiliar stimuli.

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Neuronal mechanisms underlying retention of timbre in acoustic short-term memory.

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The general goal of our research is to better understand the neuronal mechanisms that permit retention of low-level acoustic information in short-term memory (ASTM). Recently, we discovered a new event-related potential (ERP) component reflecting maintenance of pitch in ASTM, the Sustained Anterior Negativity (SAN). This fronto-central ERP component increased in negativity with memory load during the retention interval, but only when participants had to remember pitch information in order to perform the task. We wanted to study whether this component is specifically related to the retention of the pitch or if it is also present in the maintenance of other acoustic characteristics, namely, timbre. Thus, we presented sequences of sounds varying in timbre to the participants whose task was to maintain them during a period of two seconds and then judge whether a probe sequence was same or different to the first. Analyses focused on the retention period which was contrasted with a control condition in which the same stimuli were presented but participants performed instead a perceptual task without having to maintain sounds in memory. As expected, we found a significant difference between the activation recorded during the memory task and the control task. We observed an ERP component increasing in negativity with memory load but localized more posteriorly to the SAN. This leads us to suggest that neuronal mechanisms responsible for the maintenance of pitch and of timbre in ASTM might be different.

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The Effects of an Auditory Spatial Location Cue and of Response Repetition

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This study explored the possibility that the beneficial effects of an auditory spatial location cue and of response repetition may be caused by the same underlying cognitive mechanism. On each trial, participants were presented with a brief click sound (cue) in either the left or right channel, followed by a 'buzz' or 'croak' sound, also in either the left or right channel, which they were required to identify as quickly and accurately as possible. The effects of both accurately cueing target location and repeating an identification response were measured. According to additive factors logic, an interaction between these effects would provide an indication that both are driven, at least in part, by the same underlying cognitive process.

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Action verbs are the most accessible level of sound event description

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Listeners can describe sounds in a variety of ways, using aspects such as their causal properties (e.g. hammering), their psychoacoustic properties (e.g. sharp or loud), or their contextual/semantic associations (e.g. construction noises). One possible approach to disentangling the variety of ways of listening is to hypothesize that different types of information are extracted over different time courses. For example it is possible that the more immediately extracted information is taken from the sound alone whereas subsequent processing also uses context and other associations. Another possibility is that the most easily accessed description of a sound indicates privileged level within a hierarchical organization of sound events, akin to Rosch's (1976) basic semantic level. We report a series of experiments utilizing simple sound events to reveal the type of information that is the most immediately accessible. First, we generated a set of sounds easily identified at different levels of generality; the levels of description were chosen empirically after they were initially inspired by Gaver's (1993) taxonomy. One experiment measured the time needed to identify brief excerpts of these sounds. Another experiment measured priming in a lexical decision task caused by the prior presentation of these sounds. In both experiments, we varied the generality of the descriptions. Both identification and priming effects were found to be superior when a verb described the specific action causing the sound (e.g. trickling) in comparison to: (a) more general descriptions (e.g. pour, liquid), (b) descriptions using adverbs to give detail on the manner of the action (e.g. trickling evenly), (c) descriptions using nouns to describe the objects involved (e.g. water trickling). These results suggest that the information that is most immediately accessible from listening, even in a priming paradigm that requires no conscious identification, is related to the action that caused the sound.

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Research into the influence of a system of pitch and rhythm patterns on the promotion of aural attention abilities of elementary school pupils

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Attention deficit disorder appears to be a common phenomenon among elementary school pupils. This phenomenon was illustrated by research (N=97) done in different schools in cooperation with the University of Applied Science of Heidelberg (Bernhofs and Gross, 2006). Upon repeated assessment (N=166), distinct attention disorder problems were identified in 35% of elementary school pupils. To advance the hypothesis that the music parameters of pitch and rhythm evoke a positive effect on aural attention systems, a goal was set to develop a training program to promulgate aural attentiveness in elementary school pupils. The theoretical basis of this research is based on several acknowledged disciplines: 1) the structural differentiating characteristics of the attention system (Raz, 2004; Ten Hoopen, 1996), 2) the pitch and rhythm elemental development and model formations (Nazaikinskij, 2003; Cenova, 2007, Altenmueller,2000), and 3) the neuropsychological aspects of pitch and rhythm perception and processing (Peretz et al., 2007). The new training program for pitch and rhythm encompasses 3 groups of randomly chosen structural phases with a 3-sec controller function (CF) that targets aural attention ability. The structural phases last 6-60 seconds. Group A encompasses 10 base phases and selected CF elements. Group B has 10 base phases and gradually diminishing CF elements. Group C has 6 base phases but with an added acoustical interference, such as external noises, dynamic surround acoustic factors, tone variations, and pauses which all hinder perception. The relationship of CF and structured phases modulates the complexity of the training program at the level of perception and attention; higher complexity parallels longer structural phases. The training program lasts 7.5-21 minutes, and the effectiveness of this program is analyzed by a standardized aural attention test.

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Practicing with Auditory Graphs: Do Graph and Question Complexity Impact Comprehension?

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The present study on graph comprehension examined three questions: 1) Does adding sound to visual displays of graphs change performance?; 2) Does practicing with sonified graphs lead to changes in performance?; and 3) Do graph and question type affect graph comprehension? 96 real world data sets from a number of academic disciplines were taken from the DASL on-line database and graphed into a standardized format. The graphs were then randomly selected to form sets of 24 graphs consisting of 12 line graphs and 12 scatterplots, within which were nested 6 bivariate and 6 multivariate graphs. The sonified graphs were made using digitized instruments in MetaSynth to produce a one-to-one correspondence with the data points in the graphs. 60 participants were randomly assigned to either a visual-only or a visual plus auditory graph condition and attended 4 weekly 1.5 hour sessions during a 1 month period. During each session, they were presented with one of the sets of 24 graphs, which were counterbalanced across participants and sessions. Each graph was presented with four sequential questions, which varied in the level of cognitive complexity and answer format. Participants in the sonified graph condition were encouraged to replay the sonifications as many times as they wished. Data analysis revealed that participants in the visual graph condition had a 72% correct mean total response rate and those in the sonified graph condition had a 74% rate, although the difference between the two conditions was not significant. Sonified graphs led to higher correct mean responses for 4 graph and question types during individual sessions, while visual graphs led to better performance for 2 graph and question types. Practice did not lead to better performance for either graph condition. Follow-up questions showed that participants in the sonified graph condition felt the auditory display was especially helpful for the more complex graphs.

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Quantifying the segmentation of auditory necklaces

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Ambiguous stimuli such as the visual Rubin vase/face were the main focus of Gestalt psychologists. Here we focus on the ambiguity of repeating auditory patterns (which we call "auditory necklaces" -- ANs for short -- because they are best visualized arranged on a circle) consisting of notes ("ta") and rests ("-"). Imagine the AN, "... ta ta ta - - ta ta - ta ta ta - - ta ta - ...". You could perceive it either as a repeating "ta ta ta - - ta ta - " or as a repeating "ta ta - ta ta ta - - ". The AN just described can be represented as 11100110. One of the functions of the auditory system is to organize and parse temporal patterns into meaningful groupings. Here we sketch a quantitative theory to predict the segmentation of ANs. In previous studies, the task of participants was to tap in synchrony with the perceived starting beat of the AN (which we call the "clasp"). This procedure confounded motor control with perception and made the data analysis complicated. We devised an experimental paradigm to get pure perceptual data and simplify the data analysis. In our experiments, as soon as an AN was played, a circular array of icons (whose number corresponding to the number of beats in the AN) appeared on the screen. During the time of each beat (regardless of whether it was a note or a rest) the corresponding icon was highlighted. The participants' task was to click on the icon corresponding to the beat they perceived as the clasp. To eliminate any fine temporal motor control, they could click on any icon at any time. We explored the segmentation of 25 ANs, and developed a quantitative model for each of the participants to predict their segmentation. (We called a sequence of consecutive notes a "run," and a sequence of consecutive rests a "gap." Each of the 25 ANs had two runs and two gaps.) Some of the predictors we used were (1) run and gap length ratios; (2) run length and gap length differences; and (3) an information-theoretic measure of local surprise.

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Is the world the same size when I use my ears as when as I use my eyes? A test of James J. Gibson's notion of the partial equivalence of perceptual systems.

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Previous studies have shown that vision influences our perception of sounds. It has also been found that vision and audition occasionally yield equivalent perceptions. At other times, however, perceptions based on sound are disparate from those based on sight. In 1966, James J. Gibson proposed the idea of the partial equivalence of perceptual systems, the idea that different perceptual systems are capable (assuming equivalent information) of yielding identical perceptions. The purpose of the present study was to determine whether affordance perceptions were comparable across different modalities; more specifically, between vision and audition. In short, the task of participants was to determine whether gaps of various size afforded passage. It was also of interest whether the particular body dimension was an essential factor. Participants were asked whether a target (positioned 2 m in front of them) obstructed their ability to locomote in a straight path. In addition to the size of the gap, the height of the target (relative to the ground plane) was varied. The results are discussed with respect to the issue of "equivalent information" as well as the differences in modalities. Discussion will also be given to Gibson's notion of partial equivalence of perceptual systems.

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The influence of mood on the detection threshold for pure tones

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Mood has been shown to influence cognitive performance, however little is known about the influence of mood on sensory processing, and specifically in the auditory domain. With the current study we sought to investigate how auditory processing of neutral sounds is affected by the mood state of the listener. This was tested by measuring auditory detection thresholds (80% accuracy) for 1 kHz tones in a constant background noise (40 dB SPL) before and after a standard mood-induction procedure. The thresholds were determined by means of an adaptive staircase tracking method in a two-interval forced-choice task. Detection thresholds were compared between participants in four different mood states (calm, happy, sad, anxious) that could be differentiated along the dimensions arousal and pleasure. Participants in low arousing moods had lower detection thresholds compared to participants in high arousing moods. There were no differences in detection threshold between participants in positive compared to negative mood states. Thus, while there was no impact of pleasure level on auditory sensitivity, lower arousal was associated with higher auditory sensitivity. The latter finding may be explained in the light of current theories on neuromodulation in states of low and high tonic arousal.

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The Effects of Approaching and Receding Sounds on the Perception of Terminal Distance

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The “looming bias,” as reported by Neuhoff et al (2009), occurs when listeners judge approaching sounds as closer to the listener relative to receding sounds halting at the same distance. We have incorporated the virtual sound motion synthesis techniques of Jenison et al (1998) to assess the reliability and ecological validity of the looming bias. Participants are asked to indicate on a visual analog scale the subjective perceived distance of sounds presented under headphones. Two different types of moving sounds are employed to explore how well the looming bias generalizes to real-life settings: a square wave similar to the one used by Neuhoff et al (2009) and a moving motor-vehicle sound synthesized from a car-engine sample. To reduce response anchoring, participants also completed “Far” and “Near” blocks in which the stopping points of approaching and receding sounds were 15 m and 7.5 m, respectively, from the listener in virtual space. Results will be analyzed to: 1) determine whether the acoustic motion cues described in Jenison et al (1998) produce a looming bias; and 2) how more ecologically valid sound sources affect the looming bias.

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Auditory Model Designed from Principles of Survival

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We present a computational auditory model that could satisfy sensory requirements for survival of a living system. Such autonomy requires ability to decide among the meanings provided by its sensors relative to a best plan for survival. Therefore, sensory acquisitions must relate to a sense of meaning. This requirement is defined and explored in the design the model. In particular, meaning is defined in terms of three principles of survival: threat, benefit, and orientation. Thus, to make an optimum cognitive decision, the system must relate its perceptions to these three principles. To do this, the system provides auditory processing functions needed to respond to sounds much as an animal or human. There is no attempt to model neural components, e.g., no simulated cochlea. Instead, the processing system is constructed with shift registers and arrays of logical networks using a version of Edelman's selectionist pattern recognition. It recognizes and encodes temporal patterns in sequences of the acoustic signal's real and complex zeros. These patterns include waveform parameters such as direction of arrival, amplitude, and encoded waveshape features. Meaning is acquired from pattern recognizers operating in a hierarchy of in six successively longer time epochs progressing upward in six stages of cognition and terminating in complex aspects of human linguistic and emotional communication. An autonomous "protosystem" controls the fusion of hierarchical cognitive perceptions in terms of attention and awareness. All functions ard carried out in real time, synchronized with the signal waveform. Demonstrations of operation at the low-level stages of the hierarchy can be presented.

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Computational approach oriented by the Gestalt perceptual theory

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Objective: Experimental approach at the human perception based on the theories of form - Gestalt - and the Computational in order to analyze, in the laboratory context, the relations between the visual and sound stimuli, with the ultimate goal of framing a lexicon and/or basic patterns common among these that can be applied directly to a well-grounded development of GUI's – "Graphic User Interfaces ". Methodology: A computational approach that fundament the electrical signal acquisition of the brain – Event-Related Potentials (P300) – to stimuli response, based on a basic visual syntax that assumes the Gestalt phenomenology. Resources: Biopac Systems Mp 150 – Data acquisition unit "MP150A.CE"; universal interface module "UIM100C"; stimulator module "STM100C", two electroencephalogram amplifier modules "EEG100C"; Ag-AgCL lead electrodes – AcqKnowledge 3.9.0 (software); SuperLab 4.0 (software) and MatlabR2008B. Conclusions: Assuming the Gestalt phenomenology of stimuli perception with a Computational approach, namely on the signal processing and implementation, we acquire interim results of brain activity relating to the correlation between visual and auditory stimuli perception.

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The effect of motion resolution on the auditory motion aftereffect

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A long-standing debate in auditory motion perception is whether sound movement is coded by specialized auditory motion processing neurons or inferred from a sound's starting and ending points ("snapshot hypothesis"). Behavioral measures have shown greater acuity for static over moving sources, supporting the snapshot hypothesis that sound motion perception relies on static perception. These null results coincide with weak neurophysiological evidence for cells in the mammalian auditory pathway which code for particular movement vectors. Nonetheless, there is some evidence for distinctive processing of moving sounds, including neuroimaging data of specialized motion responses in right posterior tempo-parietal cortex, as well as auditory aftereffect data showing spatial sensitivity below that predicted by cells with broad static receptive fields.

Repeatedly presenting a unidirectionally moving sound source (adaptor) can induce an auditory motion aftereffect (aMAE) in which slightly-moving probe stimuli are more often heard to move in the opposite direction. According to the snapshot hypothesis, a low resolution, saltatory adaptor jumping between end points in a particular direction should produce an aMAE as strong as a high resolution adaptor moving continuously between the same points. A larger aMAE for a continuous adaptor, however, may indicate greater cell response to true auditory motion. The present experiment adapts listeners to leftward or rightward virtual moving sounds (-40-0 deg azimuth) of 2, 4, 6, or 12 jump resolutions. AMAE magnitude will be measured as a function of degree of motion resolution to determine if horizontal source motion recruits units responsive only to static source position.

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