Moved by Music: Motion, Emotion, and Empathy
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An exploratory empirical analysis was conducted to investigate the little-studied, albeit ubiquitous, phenomenon of 'being moved' by music. Using an online questionnaire, 138 participants listened to experimenter-selected and self-selected moving music. Thematic content analysis of participants' free descriptions suggests that the feeling of 'being moved' is an immersive and often physiologically-experienced one, which manifests in two forms - through beautiful-sadness (inspiring quiet contemplation) or overwhelming exuberance (motivating action). In both cases, it appears to invoke prosocial feelings and empathically engage listeners. Additionally, correlation analysis reveals a statistically significant relationship between dispositional empathy measures (Fantasy and Empathic Concern) and musical moved-ness.

Foundations of Musical and Speech Rhythm – A Pilot Study
Peter Bamikole, Aysu Erdemir, and Reyna Gordon
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Gordon et al. (2015) found an association between two seemingly dissimilar tasks: rhythm perception and morpho-syntactic production. Their finding raises more questions about the link between rhythm and syntax, and the contributions of other processes like sensitivity to musical and speech rhythm. To that end, this pilot study tests the association between measures of musical and speech rhythm within two groups (children with language impairment, and with typical development). We expect a moderate correlation that supports the aforementioned result, and can inform an emerging line of research on the role of music in acquiring complex syntax.

Changes in Music Cognition after a Theatre-based Intervention for Youth with Autism Spectrum Disorder
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A theatre-based intervention has been shown to improve social cognition in youth with Autism Spectrum Disorder (ASD). While the intervention includes musical activities, impact on music cognition had not been thoroughly measured. We investigated musical memory in ASD and changes after intervention. Using a waitlist-control design, participants (experimental=12, waitlist=7) were tested for music memory with a picture-melody matching task. There were treatment-associated improvements in music memory ($F=23.23$, $p<0.001$). Findings suggest theatre intervention may improve musical cognition in youth with ASD. This study serves as proof-of-concept for future investigations to more comprehensively assess the impact of theatre intervention on musical abilities.

Non-verbal Auditory Working Memory Across a Range of Language Skills
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Working memory is an important component of both language acquisition and music perception. While efforts have been made to study working memory in children, most tasks rely upon language-based stimuli. The current study utilized a tone-based 1-back paradigm to assess auditory working memory in children with language delay (characterized by grammar deficits) and their peers with typical language development. Preliminary results show reduced accuracy in children with language delay compared to typical peers, and performance correlated with digit-span. Our task shows promise for elucidating working-memory deficits as a contributing mechanism to language and music skills.

Neural and Behavioral Metrics of Rhythm Processing Predict Individual Differences in Grammar
Scott D. Blain, Natalie Wiens, Alexander Chern, Peter Bamikole, Magdalene Jacobs, C. Melanie Schuele, John R. Iversen, and Reyna Gordon
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Our recent work shows that individual differences in rhythm predict grammar abilities in children. The current project seeks to extend these findings by incorporating brain measures of rhythm perception and exploring rhythmic cues to complex sentences. Preliminary data from Study 1 suggests that individual differences in brain (EEG) activity during listening to rhythmic sequences predict complex syntax abilities, above and beyond behavioral measures of rhythm. We will also present preliminary data from Study 2, which additionally involves a complex sentence structure task with manipulated rhythmic regularity. These new approaches will allow us to better understand the complex relation between rhythm, grammar, and underlying neural resources.

The Effect of Music on Cognition: One and Two Year Follow-ups
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We studied the effects of music instruction on cognitive and social functions in at-risk children without access to music instruction, using state-of-the art neurocognitive assessment tools. Children were randomly assigned to either Basic Music class or wait-list. We assessed students starting fall 2013 and ending spring 2016 using the Cogstate battery working memory, executive functioning and social cognition. For our total sample, we have one-year follow-ups for 48 students (Tx=27, C=21) and two-year follow-ups for 39 students (Tx=21, C=18). Outcomes showed that children receiving music instruction performed better on the working memory and social-emotional tasks than wait-listed children.

Influence of rhythm on grammatical performance in children with cochlear implants, developmental language disorders, and typical development

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Our study tests how well children with typical development (TD), specific language impairment (SLI), and cochlear implants (CI) perform on grammaticality judgment tasks and complex syntax tasks in English after listening to either rhythmically predictable or unpredictable musical sequences. Our collaborators showed that both French children with TD and SLI improve in performance after listening to rhythmically predictable musical sequences. Our results will have implications for elucidating mechanisms for auditory processing and in employing innovative, music-training elements during speech therapy for patients with developmental language disorders or cochlear implants.

Music-Paired Stroke Rehabilitation: In-Hospital and Post-Discharge Effects

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For stroke patients, post-discharge continuance of therapy is highly recommended (Forester, et al., 2015) to increase functioning (Chumbler et al., 2012; Forester et al., 2015). Thus, the proper execution of therapy post-discharge is a necessity. The proper execution would require memory for the therapeutic exercises. The combination of music and in-hospital stroke therapy has demonstrated success (Jun, Roh & Kim, 2013; Sarkamo, et. al, 2008), but has not been investigated with personally-relevant music nor with post-discharge therapy. Findings will include determining the effectiveness of personally-relevant music as a technique for improving the success of in-hospital, and in turn, post-discharge rehabilitation.

PRIDE (Perseverance, Respect, Inclusion, Doing the right thing, Excellence) in a group-based music education program

Anja-X. Cui, Melina Dedrichs, Andrew Belyea, Lola L. Cuddy, and Julia E. Brook
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We assessed musical, social, and academic performance of 36 elementary school students in a disadvantaged Canadian neighbourhood. Nineteen students were part of an El Sistema inspired program taking place over 26 weeks. Data were collected from students, parents, classroom teachers, and the Sistema staff. Exploratory analyses indicate positive impact of program participation on self-confidence and reading skills, which will be further explored as the program continues in the next school year. This research contributes to our understanding of how a group-based music education program may enhance the individual, the school, and the community.

Tempo Versus Harmonic and Melodic Pacing in a Corpus of Rock Music
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As the tempo of a song increases, its melody and chords move more quickly. Examining a 200-song corpus of rock music, however, this principle does not hold when comparing tempo to harmonic and melodic pacing between songs. Specifically, median chord lengths and melodic note durations per song-as measured in seconds-generally remain constant across all tempos. These results help explain why different listeners often entrain to different metric levels in rock music (Moelants and McKinney 2004, Levy 2011), since the speed of the drum pattern may be considered distinct from the disbursement rate of harmonic and melodic content.

Musician and Non-Musician Preferences for Hearing Aid Gain and Compression Settings
Kristen D'Onofrio and Todd Ricketts
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Hearing aid settings are commonly determined using validated prescriptive methods. Because these methods were developed primarily to maximize speech understanding, it is unclear whether they are appropriate for other sounds, such as music. Further, it is unknown whether hearing aid setting preferences differ for musicians versus non-musicians. The purpose of this study was to evaluate potential group differences between musicians and non-musicians in their self-adjusted (SA) settings for music and speech stimuli. Sound quality and strength of preference ratings across prescribed settings (NAL-NL2) versus SA settings were also evaluated. Results and implications for musician hearing aid fittings will be discussed.

In the future, music will be an integral part of the healing process
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Vitamusic represents an unfolding organic process in the research and development of natural methodologies through the medium of music. It utilizes the natural process of bio-energetic transference, known as healing, in which music can be a conduit for remedy. Its primary foundational pillars are the continued understanding of the 'human instrument', which includes the mind and body; music as a means of expression and carrier of energy; and the ever new understandings and study of electro-magnetism. A study now in process is evaluating the role of music, as an intervention to reduce patient anxiety in the perioperative arena.

The effects of music preference on listening levels

Max Gilbane, Kristen D'Onofrio, and Reyna Gordon
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Despite the ubiquity of music, many of its mechanisms and the behaviors of its listeners are still poorly understood. The potential for loud music listening to cause hearing loss has been an active line of research for many years now, although the factors determining the volume at which one listens have not been systematically studied. The purpose of the proposed research is to characterize the relationship between an individual's preference for a piece or type of music and the volume at which they listen to it. It is hypothesized that listeners use higher volumes for music that they prefer.

A study design for the standardization of rhythm discrimination tasks to better assess neurological deficits

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Rhythm discrimination tasks have been used to assess language and motor deficits in various neurological disorders. Currently, in the literature there is a lack of standardization among rhythm discrimination tasks being used for these assessment purposes. Standardization of these tests could improve the efficacy of prescribing therapy treatment options for neurological disorders. This presentation proposes a study design that will investigate how various musical elements may interact with each other in rhythm processing and will review the current literature to provide an analysis on the current research lines using rhythm discrimination tasks and their implications for assessing therapy options.

Genetic Implications of Rhythm and Grammar Development

Michaela Novakovic, Genevieve Kupsky, Ashley Hirsch, Nancy Cox, and Reyna Gordon
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Recent literature suggests a connection between rhythm and grammar development, although the genetics driving this relationship are not yet known. We are investigating genotype-phenotype correlations using the expression-based profiling tool, PrediXcan, and Vanderbilt's database of linked medical records and phenotypes, BioVU. Here, PrediXcan is used to find genes highly expressed in individuals with Specific Language impairment (SLI), and Synthetic Derivative is used to identify genotypes more frequent in SLI. Complementary information on the role of these genetic mechanisms will be assessed by comparing the rhythm perception, spontaneous motor tempos, and genotypes of children with and without SLI.

Hearing the Difference: Associations Between Phonological Awareness and Music Perception Skills

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Research suggests that musical ability correlates with phonological awareness in children (Anvari et al., 2002; Carr, et al., 2014). However, studies vary in the specific music and phonological awareness skills being measured (Gordon, Fehd, and McCandliss, 2015). The proposed poster will report findings on a study that examines the relationship between music discrimination abilities and elision and blending skills in preschool children. Data will be drawn from preschool classrooms that serve low-SES children (n=50). A regression model will be used to compare performances on the AUDIE music test and the phonological awareness subtest of the Test of Early Preschool Literacy.

Musical Engagement and Social Communication in Early Development

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Social communication makes extensive use of predictable, rhythmic behaviors and individuals are acutely sensitive to the timing of these behaviors beginning in infancy. One example of such communication is infant-directed singing, a universal form of parent-child interaction that captures and maintains infants' attention and modulates their arousal levels. This research examines how musical interactions, as a form of rhythmic, multisensory, social engagement, scaffold and promote social communication development in typically developing infants and those with or at-risk for developmental disabilities. For example, this research demonstrates how rhythm directs attention to socially meaningful information across the first years of life.

SERENADE: Social and Rhythm Engagement in Autism Spectrum Disorder

Miriam Lense, Rita Pfeiffer, Samantha Gould, Jeremy Bennett, Kacie Dunham, Sara Beck, Gloria Han, and Reyna Gordon
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The SERENADE (Social and Rhythm Engagement in Autism Spectrum Disorder) research program provides and studies the impact of multimodal music engagement experiences on social development in children with autism spectrum disorders (ASD) and emotional well-being in their parents. The SERENADE program examines how participation in parent-child music classes impacts social communication skills, parent-child synchrony, parental stress, and parents' use of music-based strategies to promote social engagement. Additionally, this research program examines increased sensitivity to the rhythm of social interactions as a mechanism by which musical experiences promote social behavior in ASD.

Linguistic Rhythm, Musical Rhythm and Reading Skills: ERPs and Individual Differences
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Previous research showed that sensitivity to language-specific rhythm play an important role in speech perception. Using the event-related potential (ERP) method, we examined whether sensitivity to the rhythmic cues given by the pattern of stressed and unstressed syllables may facilitate comprehension during silent reading as well. In addition, we considered a link between implicit speech rhythm sensitivity and individual differences in musical and reading abilities using ERPs in combination with standardized behavioral assessments. The domain-general nature of rhythm processing skills and potential benefits of music instruction for reading intervention will be discussed.

Piloting a Rhythmic Speech Production Paradigm for Children and Potential Links to Language and Music Skills
Rita Pfeiffer, Alison Williams, Carolyn Shivers, and Reyna Gordon
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A growing body of work points to a relationship between rhythm abilities and language skills, including grammar. Individual differences in sensitivity to rhythmic aspects of speech could be a mechanism underlying the association between musical rhythm and grammar skills found in our preliminary work. To assess this, we first modified a rhythmic speech production task and conducted a pilot study in which participants speak short, metrically regular phrases along with an isochronous metronome. Pilot results show promise for future use of the paradigm to test an overlap of speech rhythm sensitivity, musical rhythm perception, and expressive grammar abilities.

Detecting the tonic in a tonal heptachord
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Perceptions related to detecting the tonic pitch in a diatonic major key are an understanding of tonality. This study seeks to determine if the tonic is aurally discernible by individuals from two groups-one musically sophisticated and the other unsophisticated-when asked to identify if an isolated pitch is or is not the tonic of a major key after having just heard all members of that key played simultaneously, as a heptachord.

Identifying three sound factors associated with each of the 11 basic musical intervals
Marianne Ploger
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What are the sound properties associated with each musical interval that allow us to distinguish one from another by ear? Each of three perceptual factors, observed by Ploger to help listeners of all levels to identify di-chords by ear in real time, and currently employed in teaching students at

the Blair School of Music, will be objectively tested to determine both their validity and usefulness.

What is the Effect of Music on Memory among Persons Diagnosed with Alzheimer's Disease?

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This review of literature attempts to analyze the effect of music on memory among persons diagnosed with Alzheimer's. In an experiment conducted by Haj, Fasotti, and Allain, memories evoked while listening to music were higher in specificity than those evoked in silence, were rated as more positive, and were evoked, on average, 5.33 seconds faster than those evoked in silence. In a study conducted by Simmons-Stern et al., patients were more likely to encode every-day knowledge when it was presented through song. A case study performed by Cudy and Duffin supports the belief that musical memory is spared among patients.

Medical Auditory Alarms: Exploring the Signal-to-Noise Ratio

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Sound exposure in the hospital can have deleterious effects on patients and practitioners. Clinicians perform worse on tasks involving patient monitoring in noisy and highly attentionally demanding environments. Our experimental paradigm determines near-threshold auditory perception of alarms, and then uses clinical scenarios to determine the stimulus-response relationships for changes in auditory alarm intensity, spanning negative to positive signal-to-noise ratios (SNRs). There is preserved performance measured by response time and accuracy to a clinical task at -11 dB as compared with +4dB with worsening at more negative SNRs. Thus, clinician performance is maintained with alarms that are softer than background noise.

Impact of Rhythmic Auditory Stimulation on Physical Activity Levels and Ambulatory Walking Behaviors of Children During the Early Phases of Cancer Treatment

Catherine R. Smith, Lindsey Sharpe, Avery Mixon, and Martha Summa-Chadwick
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Physical activity (PA) is reduced during cancer treatment in children (Winter, Muller, Brandes et al) and remains low in survivors, increasing their risk of developing Exercise Deficit Disorder (EDD) (Faigenbaum, Myer). This research examines the effect of Rhythmic Auditory Stimulation (RAS) (Thaut et al) on PA activity levels, cadence and gait speed in children recently exposed to cancer. Fifteen minute preferred genre music segments - each reflecting 5% increase from baseline preferred self-selected walking speed of each participant - will provide the RAS intervention via individual iPod and will be measured with StepWatch Activity Monitor for PA assessment.

The Potential Impact of Singing on Multisensory Integration in Children with Autism Spectrum Disorder: A Pilot Study

Alex Tu, Wayne Kuang, Julie Conrad, Jacob Feldman, Emelyne Bingham, and Tiffany Woynaroski
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Many children with Autism Spectrum Disorder (ASD) have impairments in language use and understanding, which requires multisensory processing. Children with ASD on average report reduced multisensory integration relative to typically developing peers. The objective of this pilot study is to examine whether sung speech, which provides enhanced multisensory cues, may boost integration in children with ASD by increasing their perceptual awareness of the synchrony between visual and auditory cues relative to spoken speech. Obtained results could support the notion that music is a modality that may increase multisensory integration, and possibly even support language learning in children with ASD.

Assessing Prosody-related Language Skills in Typical and Atypical Language Development

Chloe Vaughan, Scott Blain, Katherine Jones, Uma Soman, Ashley Hirsch, J. Devin McAuley, and Reyna Gordon
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Language learning relies on the ability to extract words from the complex speech signal, in part via expectations generated by preceding intonation and timing patterns; moreover, discrimination of prosodic patterns may contribute to higher-level language skills. Here we investigated prosody-related skills in children aged 5-7, with typical language and language impairment. In Task 1, participants listened to an artificial language, and identified whether sample words were present in the language. In Task 2, participants matched lowpass-filtered stimuli to non-filtered stimuli. Results will be used to study individual differences in prosody skills and their relation to musical rhythm and grammar skills.

Do children with language impairment benefit from music and movement training?

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The link between rhythmic ability and language skills is increasingly well-documented. Specific language impairment (SLI) is characterized by deficits in grammar and recent studies have shown a connection between rhythmic ability and grammar skills among children with SLI. This study investigates the potential effects of a 3-month musical training program (weekly Suzuki violin lessons and rhythmic movement classes) on rhythm and language measures in children, ages 5.5 - 7, with SLI. We also examine how best to capture musical and linguistic progress of children throughout the study, and we propose a behavioral coding system to evaluate efficacy of the music lessons as treatment.

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Music is Patterns!: Measuring Preschoolers' Sound Pattern Knowledge and Relations to Early Spatial and Numerical Understanding

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Music is inherently mathematical. For example, establishing a rhythm involves utilizing concepts of space, number, and patterns (Geist, Geist, & Kuznik, 2012). Thus, making and listening to music early in life could support children's math achievement. Currently, we are developing a sound pattern measure to complement a visual pattern measure we have developed with 4-year-old children. We then aim to examine how these measures relate to each other and to children's concurrent number and spatial skills. Given the potential benefits of music, our work helps to understand the skills children likely need to make and understand it.