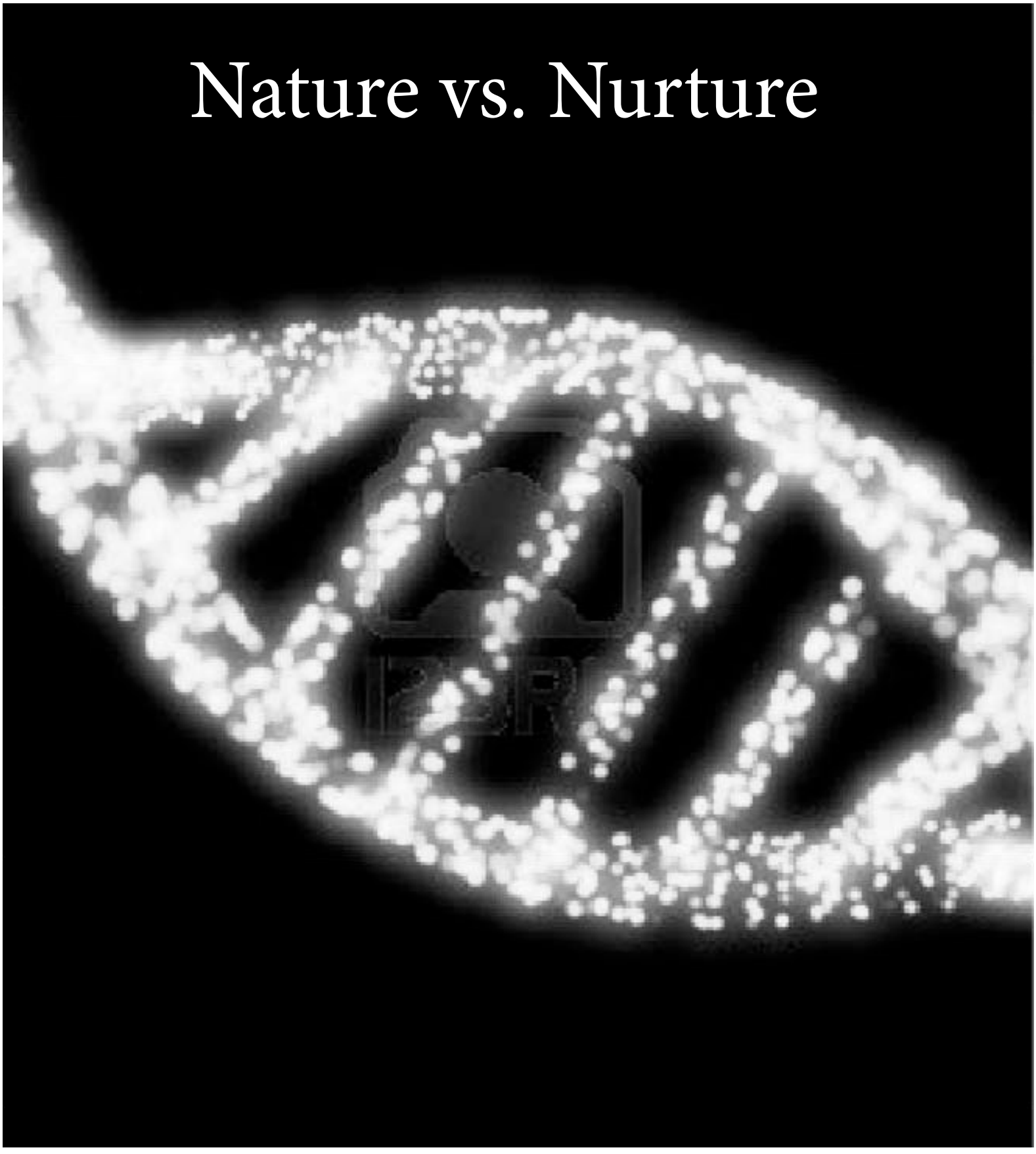
Nature vs. Nurture



February 15, 2013

Presented by

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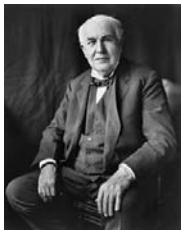
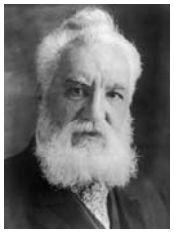
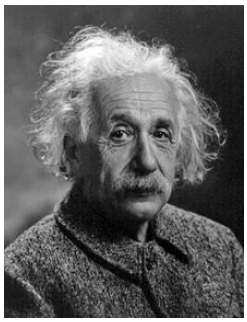
DIANNE BRUMLEY

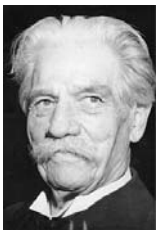


The Intelligence of Music







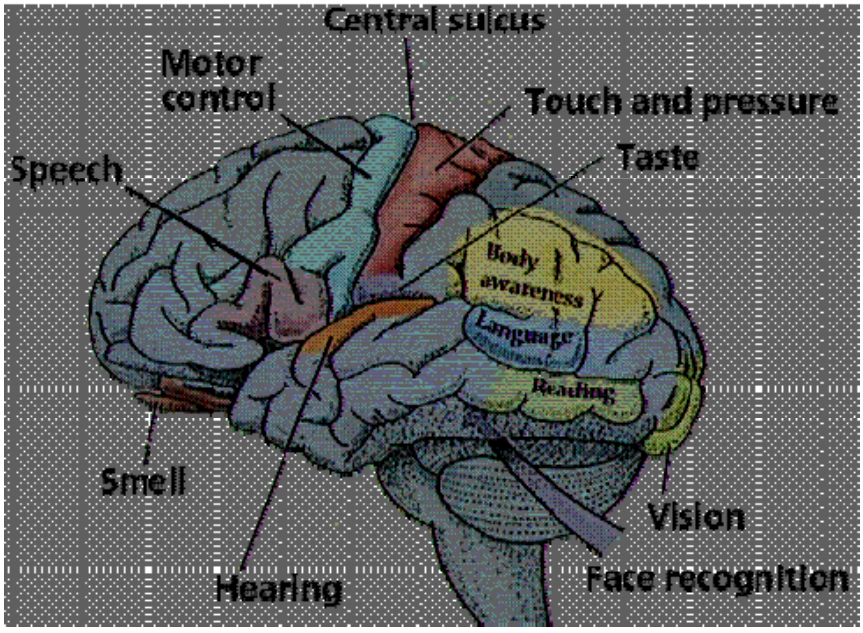


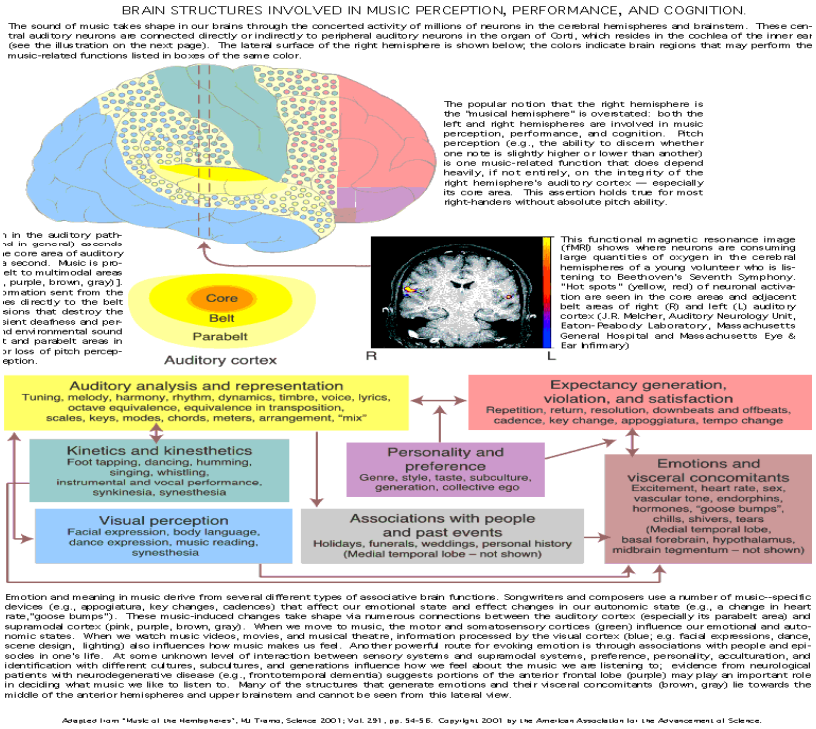
Outline

- Anatomy
- Music and Cognition
- Mechanisms
- Research and Data
- Practical Applications

Nature vs. Nurture

- Relative importance of an individual's innate qualities versus personal experiences
- Music positively influences executive functions, language functions, and even intelligence
- Carries over to all areas of life
- Are people “naturally gifted” or can you become smarter with exposure?





Music and Cognition

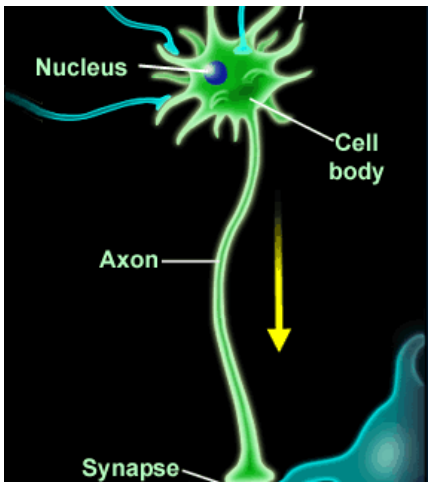
- Positive correlations between musical training and reading abilities
- Influence spatio-temporal abilities
- Improve speech prosody
- Increase verbal memory
- Contribute to second language phonological proficiency
- Increase general intelligence

Long-Term Observations

- Protect cognition against normal decline in older age as well as the onset of dementia
- Has been shown to enhance writing performances in children with developmental dyslexia and non-dyslexic children
- Contribute to regeneration of brain function after neuro-devastating illness such as stroke via Melodic Intonation Therapy

Mechanism of Effect

- Brain plasticity
- Neurons communicate with each other
- Change with time and experience
- The brain is not static
- Music as a model for brain plasticity



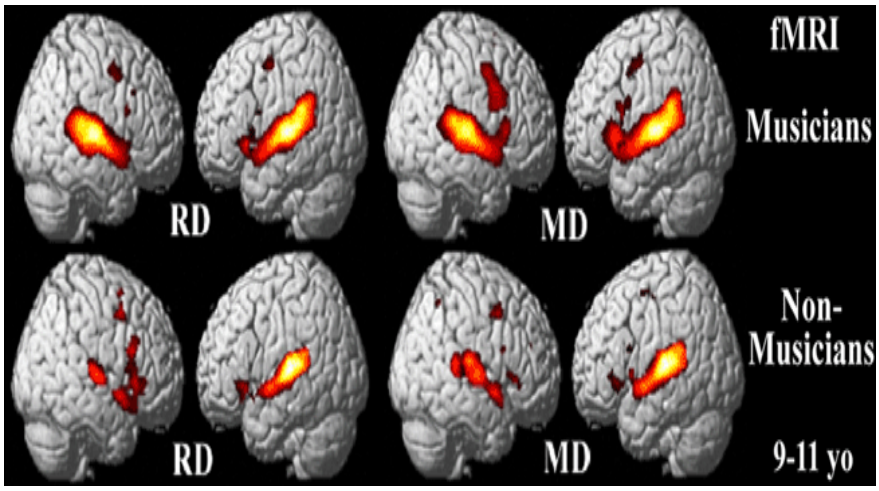
Studies and Music

- Cross sectional: musicians and non-musicians are studied at the same point in time→ anatomical or functional brain measurements are taken
- Short-term longitudinal studies: subjects have undergone a specific training intervention- last several weeks-months
- Long-term longitudinal studies: subjects have undergone longer training (years)

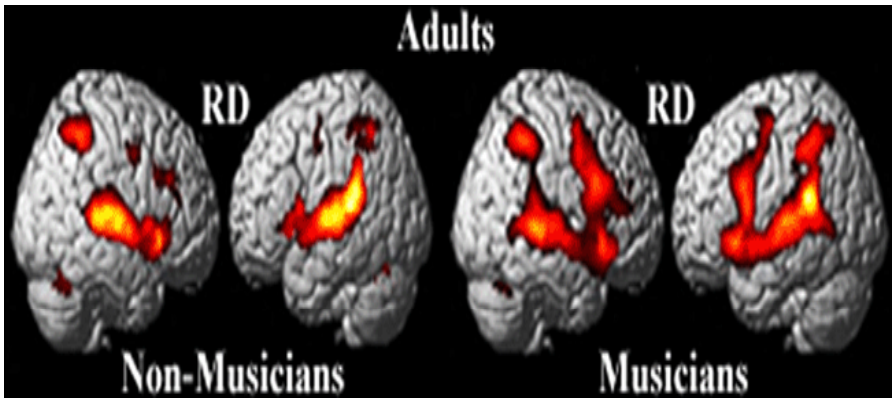
Structural Brain Plasticity

- 6 year old children received instrumental musical training for 15 months (compared to children receiving non-musical training):
  - learned to play their musical instrument
  - exhibited changed anatomical features in brain areas known to be involved in the control of playing a musical instrument

Musicians vs. Non-Musicians

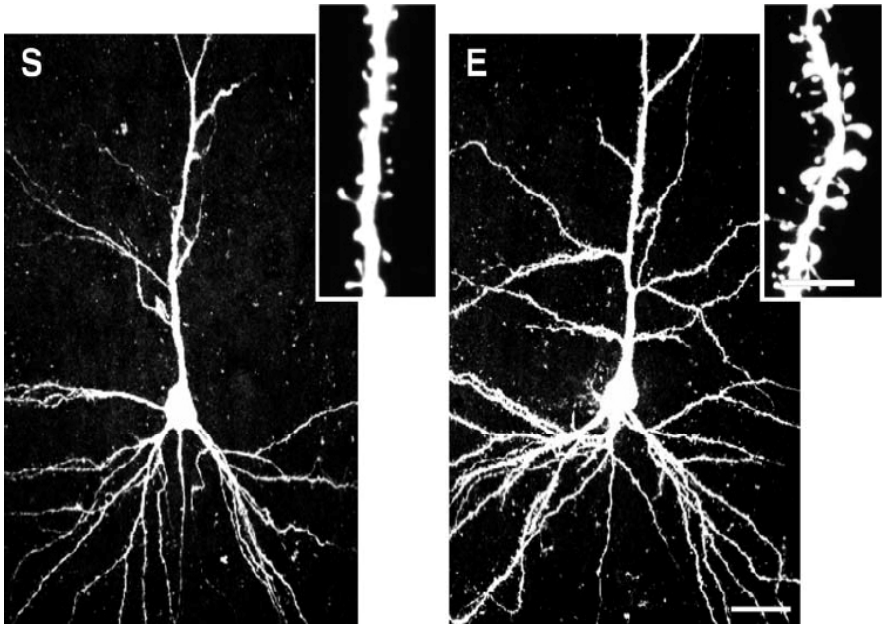


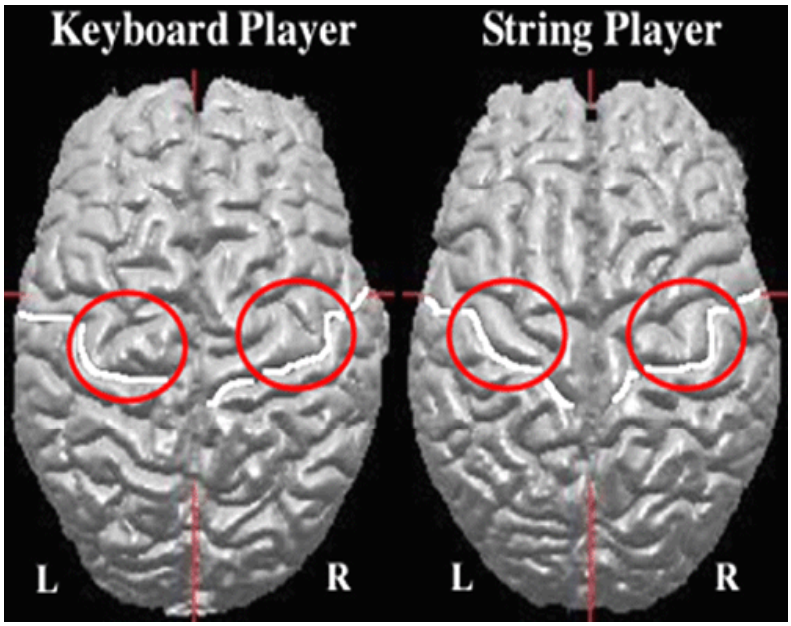
Over time…



More practice = more neurons

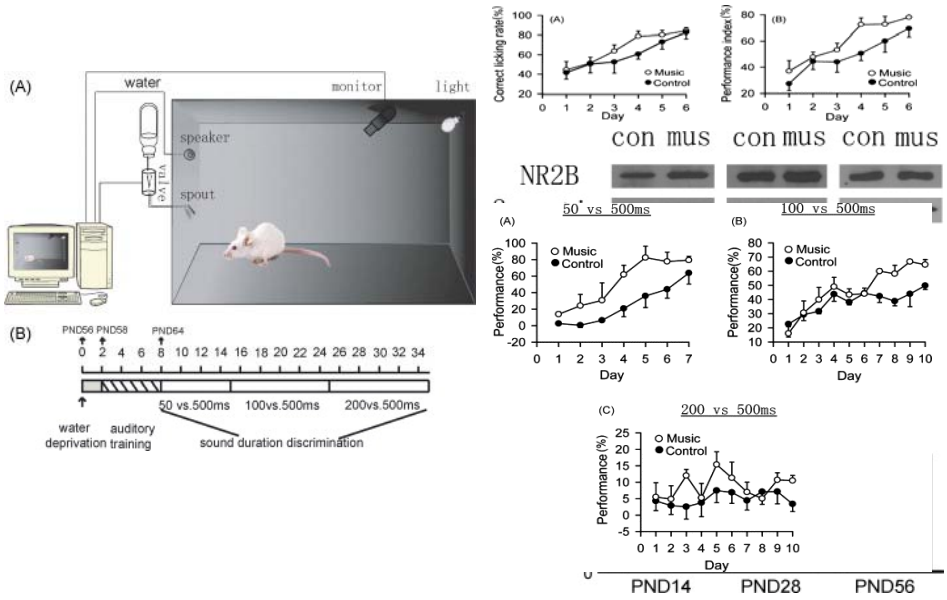
- Volume of grey matter (neurons) in the motor, auditory, and visual-spatial brain regions of professional musicians was larger when compared with a matched group of amateur musicians and non-musicians
- Strong association between structural differences, musician status, and practice intensity





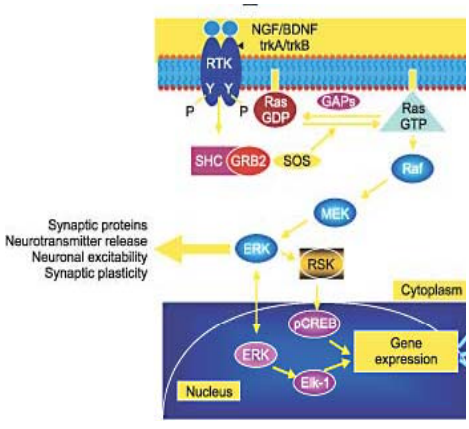
Music at the Molecular Level-Animal Studies

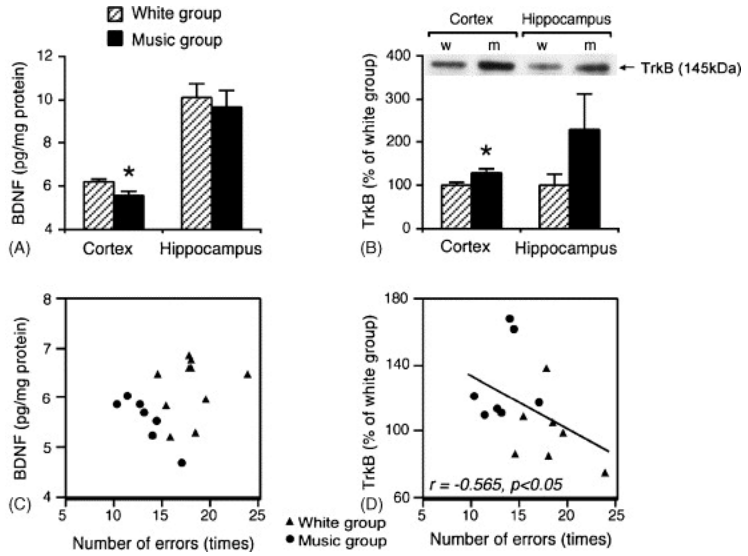
- Infant rats exposed to music as early as 14 days after birth:
  - Measured the expression of the protein NR2B in the auditory cortex in music-exposed rats and in those that did not hear music
  - Found that more proteins were made in the rats that heard the music→ performed better when given a task (learned)



Learned behavior

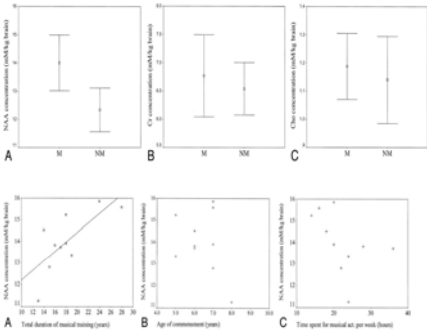
- Intra-cellular proteins in rats exposed to music:
  - Brain-derived neurotrophic factor **(BDNF)** and its receptor, Tyrosine kinase receptor receptor B **(TrkB), PDK1**, and mitogen-activated protein kinase **(MAPK)**
  - Increased levels of these proteins
  - Completed a maze learning task with fewer errors that the white-noise exposed mice who had lower levels of these proteins





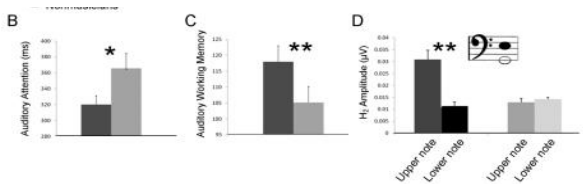
Human Studies

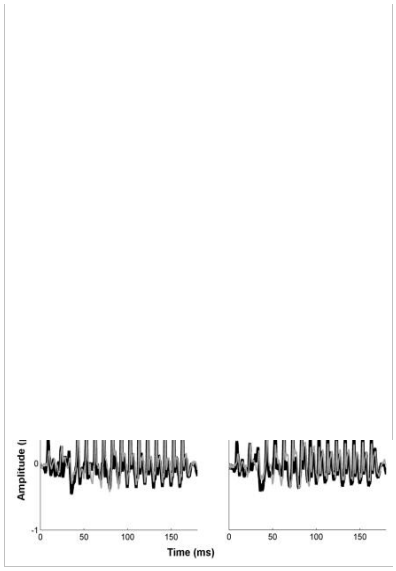
- Quantitative protein MR spectroscopy (MR Spect)
- Measured N-acetyl aspartate concentrations between musicians and non-musicians
  - Higher NAA concentrations in the musicians correlated with the total duration of musical training and activity



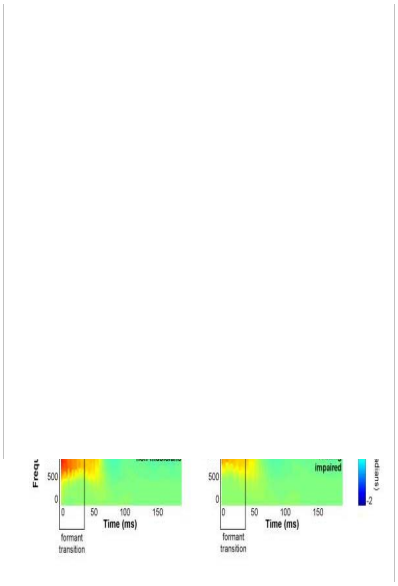
Language and Music

- Several groups have seen changes in children via EEG after just 20 minutes of piano training
- Activations in the language areas of the brain
- Strong cross-modal link between motor commands and the representation of auditory information





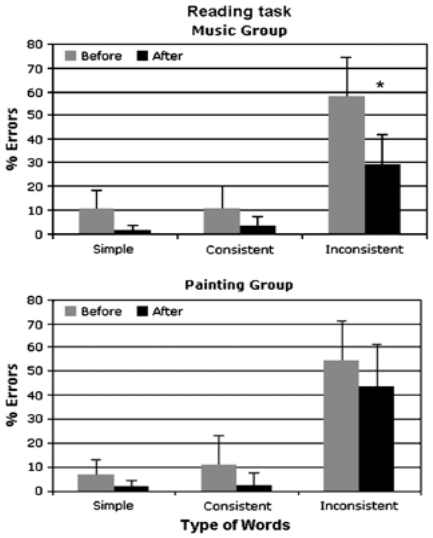
Compared to nonmusicians, musicians' speech processing is more resist



Core neural mechanisms that are deficient in poor readers are enhanced in musicians

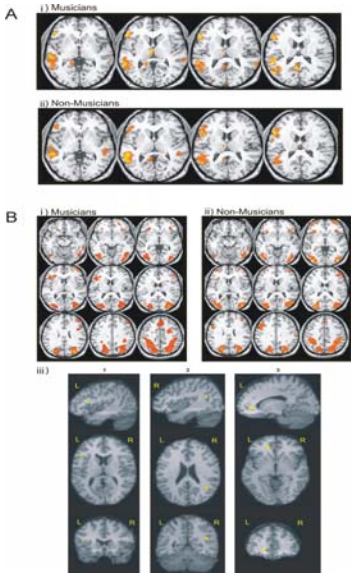
Word recognition

- After musical training children were able to differentiate similar words more effectively compared to children who were trained in painting
- Studied for 30 weeks
- Brain waves were recorded via EEG



Shared neural networks

- Anatomical differences in Broca's area between musicians and non-musicians
  - More neurons in this area in musicians than in non-musicians
  - Authors concluded that as non-musicians age there are age-related volume reductions in certain parts of the brain but not in musicians



Executive Function

- Extended musical experience enhances executive control on a non-verbal spatial task and auditory tasks
- Greater IQ increase in children enrolled in music classes

TABLE 1
Mean Sample Characteristics of the Four Groups of Children

Sample characteristic	Group			
	Keyboard	Voice	Drama	No lessons
n before lessons	36	36	36	36
n after lessons	30	32	34	36
Age (days over 6 years)	74 (28)	102 (28)	75 (85)	113 (80)
Family income	4.6 (1.3)	4.3 (1.4)	4.3 (1.4)	4.1 (1.4)
Full-scale IQ before lessons	102.6 (8.8)	103.8 (10.9)	102.6 (13.6)	99.4 (9.7)
Full-scale IQ after lessons	108.7 (12.5)	111.4 (12.6)	107.7 (13.8)	103.3 (9.9)

Note. Standard deviations are in parentheses. Age is listed as days over 6 years on September 1 (before lessons). Family income was measured in increments of $25,000 (1 = less than $25,000; 2 = $25,000–$49,999; 3 = $50,000–$74,999; and so on). There was no difference among groups in age, family income, or full-scale IQ when the children were tested initially (before lessons). The difference among groups in full-scale IQ after the lessons was reliable ($p < .05$).

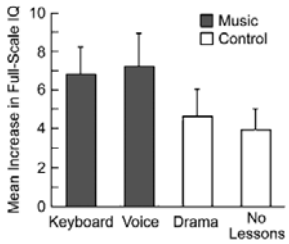


Fig. 1. Mean increase in full-scale IQ (Wechsler Intelligence Scale for Children–Third Edition) for each group of 6-year-olds who completed the study. Error bars show standard errors.

Future directions

- Is there transfer from musical to non-musical skills?
- Practice attention, planning functions, memory, self-discipline
- Musical performance demands high levels of:
  - control though the need for selective attention and inhibition
  - switching
  - updating and monitoring

Integrating science into music education

1) Accept that most people don't understand the WHYs and HOWs of music education

2) Our job is to educate:
  - Other individual music educators
  - Students
  - Administrators/Decision-makers
  - Parents/Community

Individual Music Educators

- Be informed (ignorance is not bliss)
- Know the research!
  - The data concerning cognitive and other benefits of music education is impressive
  - Be able and willing to clearly and concisely articulate a realistic rationale for teaching music
  - cite the benefits of what we do and why we do it
  - Engage in critical thinking and meaningful problem solving
  - Don't argue your points based on feelings and emotions- those above you will "tune" you out

Teamwork

United we stand, divided we fall – become a musical unit, establish partnerships, collaborations and interdisciplinary links that corroborate what we know about the benefits of music education.

Students

- Do you truly believe that a music education offers cognitive benefits?
  - Add academic rigor and comprehensive musicianship to rehearsals in order to build musicians rather than just teaching pieces of music / songs
  - Explain how you're adding difficult lessons- parents and administrators respond well to this (especially in competitive districts)
- Evaluate: What are you teaching? What are they learning?
- How do these skills relate to the students' real world – school, work, life? Inform them.
- Are your students passing their other courses? This goes beyond being eligible for your next contest or performance.

Administrators/Decision Makers

- "State of the Program"
  - Compile and provide an annual report to communicate the goals and accomplishments of your music program
  - This should be more than just ratings and all-staters
  - Include student academic accomplishments, leadership accomplishments, community involvement, ACT/SAT results, college acceptances, etc
  - Again…facts will speak for themselves
  - Use standardized test results to help tell your story. Are band, choir and orchestra students scoring better than the general student population? **Have your testing department help you do the research**
  - **Present your data in an organized form- spread sheet/word document**
- Know the people, know the processes, know the environment and know what is happening
- Be ready to respond quickly with knowledgeable and accurate information

Parents/Community

- Provide opportunities for people to see and learn about the process of music making
- Be creative
- Engage people in the process. Anyone can be a potential constituent
- Remember: It's about the students and their music education
- HOW music will make them smarter, more compassionate, help with grades, etc→ you need to be ready to articulate this
- Become a public relations / advertising specialist
- Tell your positive music education story at every opportunity

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